LARK JEWELRY

THE Ultimate JEWELER'S GUIDE

THE ILLUSTRATED REFERENCE OF Techniques, Tools & Materials

JOANNA GOLLBERG

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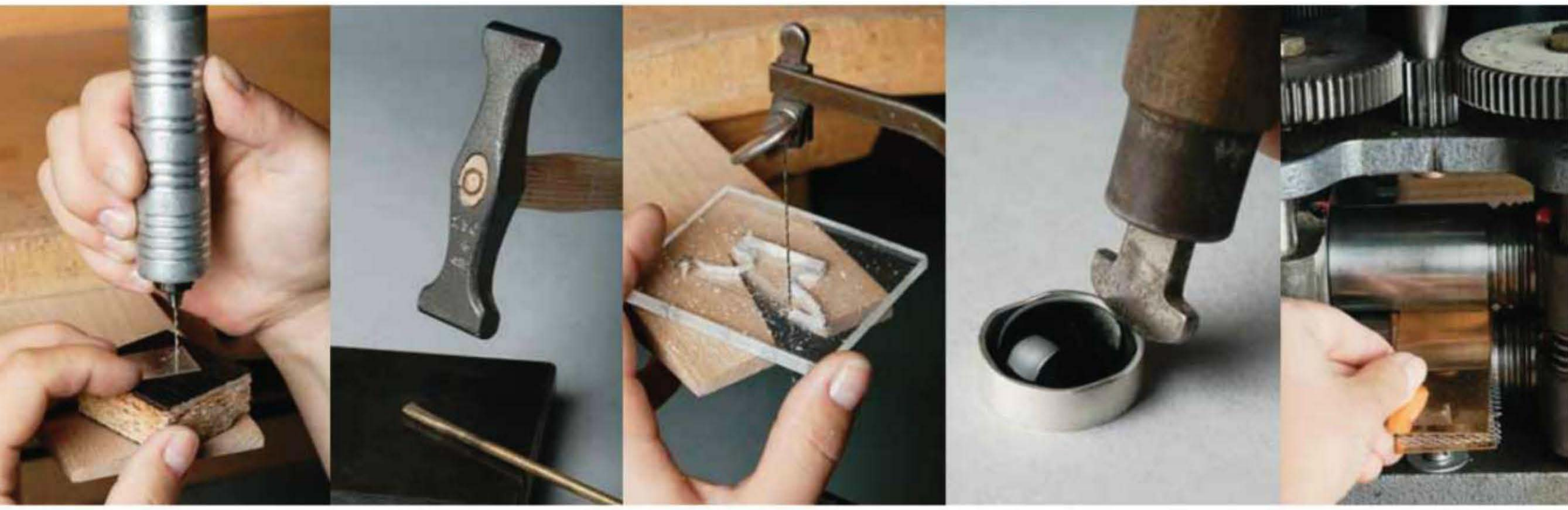

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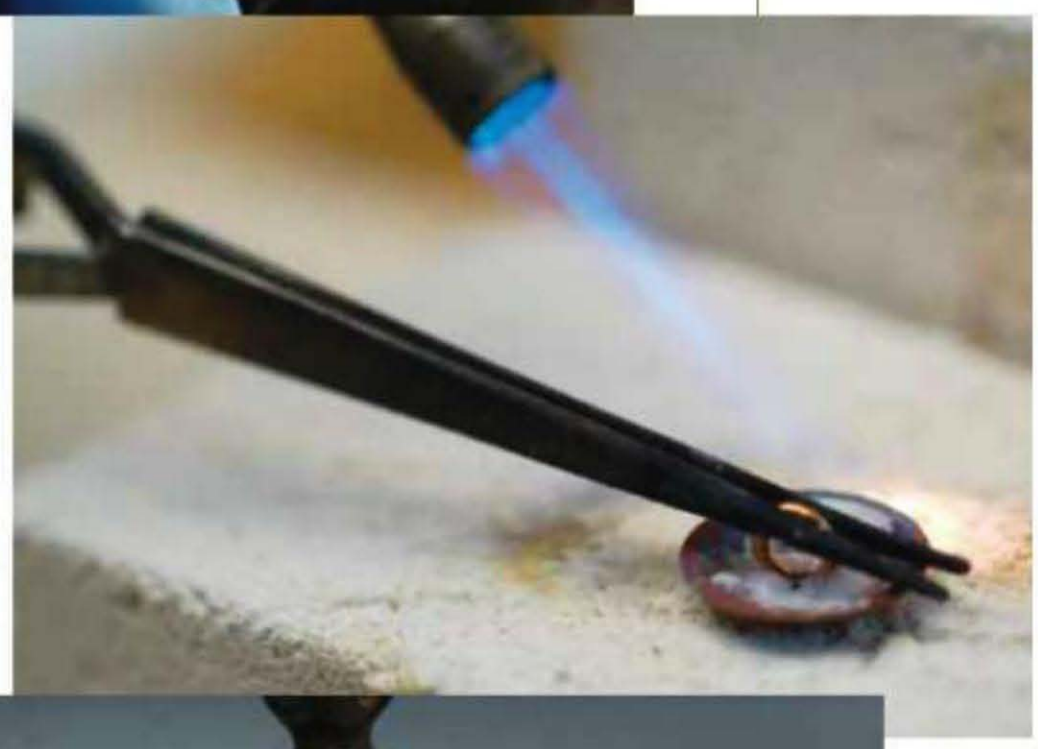


THE ULTIMATE JEWELER'S GUIDE. It's all about the fundamentals. It's about giving you what you need (and nothing you don't) in the clearest, most accessible way possible. This is the book you'll keep on your workbench rather than your coffee table. It's the one you'll pick up when you need to learn a new skill or practice a developing one. It's the one you'll turn to when you're in need of a creative solution or you just need to remind yourself how something is done. You won't find step-by-step projects or gallery photos here. Directions for making specific objects and inspirational images are undeniably useful and fun to see, but this book is different. It's hardworking and very hands-on.

A reliable reference, the ultimate guide.

Since you'll be turning to this book time and time again, the information is organized in a very user-friendly way. Each chapter has a color-coded tab so you can quickly locate different topics. Each step-by-step process is clearly presented in a different folder. Every new tool that is introduced has its own photograph and is defined in a special box. Tips, tricks, and worthy short cuts are featured frequently. Clear and abundant how-to photographs and illustrations are used in tandem to communicate actions and ideas most effectively and efficiently.

This handbook covers the most important techniques, materials, and tools for making jewelry. The information on materials includes basic metallurgy, the precious metal market, and refining. There is a thorough overview of the principal jewelry tools, including

their purchase, customization, maintenance, and care. Next comes an encyclopedia of key metal techniques, including fabrication basics, hot and cold connections, forming, texturing, mixing metals, constructing findings and mechanisms, stone setting, finishing, and safety.

Jewelry making is a dynamic art. As new tools, materials, and techniques are introduced and as the path of your work grows and changes, there is much to be learned. Knowledge is the key to translating what's in your imagination into a tangible object. Whether you are just beginning your journey or are an accomplished professional, a sound, practical knowledge of the fundamentals is essential to your success. Jewelry is a pleasure to create, to wear, and to behold, but truly great jewelry must be made well. Have a good time in your learning and in your process. Use this book to guide you though your practice, to advance your understanding, to increase your skills, and ultimately, to improve your unique creations. I sincerely hope this book helps you to make lovely jewelry and to enjoy your time doing so to the fullest.

Tobin Yousey.

Metals

Many different types of metals are readily available for making jewelry. This chapter focuses on the metals most often used in the jewelry industry and by craftspeople, but touches on some metals used in nontraditional jewelry, too.

Metal Classification

The two main categories of metal are ferrous metals, which contain iron, and nonferrous metals, which do not contain iron. Noble metals are a subsection of the nonferrous metal group. In their raw state, noble metals are unchanged by elements in the air. Noble metals include silver, gold, and platinum and are considered in our society to be precious metals. Base metals are another subsection of nonferrous metals. Along with precious metals, base metals are commonly used in jewelry. Base metals include copper, brass, bronze, aluminum, and more. Alloys can be made of both ferrous and nonferrous metals.

Noble Metals

Noble metals exist in nature and are extracted in their raw form. In this pure state, noble metals are unchanged by elements in the air. In creating jewelry, it is easiest to fuse these metals to join them, but they can also be soldered. Most jewelers opt to use noble metals in their alloy form rather than in their raw state.

Gold

Famous for its appealing color and shine, gold is the most malleable of all metals, meaning it can be worked to the greatest extent without cracking. For example, gold can be flattened to 0.000005 of an inch (0.00013 mm), becoming a thin foil that is almost transparent. Gold is the most ductile of metals—1 ounce of pure gold can be drawn into a wire that is several miles long. Gold also resists corrosion.

Platinum

Platinum is malleable, ductile, and resists corrosion. Its dark gray color is attractive, and its high specific gravity—the density of a substance relative to the density of water—is desirable to many jewelry wearers. Platinum is a very popular metal in the jewelry industry, especially for use with precious stones such as diamonds, not only because of its color, but because it provides the most security for diamond settings.

Palladium, (right), ruthenium, rhodium, osmium, and iridium are byproducts of platinum ore. Palladium and ruthenium are often used in platinum alloys. These metals can make larger platinum jewelry pieces lighter and also increase the hardness and strength of the metal. Palladium is gaining in popularity due to its rich, silver-gray color and its lower cost in comparison to platinum and white gold.

Silver

A cool, bright metal, silver is second to gold in its malleability and ductility. Silver can be highly polished and reflective and is resistant to corrosion. These facts, combined with silver's natural beauty, are what make it so popular for hollowware items. Of all the metals, silver is the best conductor of electricity but it is rarely used for this purpose. Because of its lower price, copper is most frequently used in industrial applications.

Base Metals

These metals are commonly used in jewelry making. A beginner will find them inexpensive and easy to work with while learning new skills. Base metals come in many different colors, which can add interesting effects when used with different techniques. The soldering of these metals is basically the same as with precious metals. Even though different metals have different melting points, they can be used in combination with ease.

Aluminum

Aluminum is a very light, very white metal that is quite malleable, ductile, and corrosion-resistant. The best way to join aluminum is through cold connections. Although technically possible, it's quite difficult to solder and weld aluminum. Aluminum can be anodized. Anodizing is an electronic process that produces an oxide-resistant film on the surface of aluminum. This oxide film can be dyed a wide range of different shades and can make for intensely colorful metal jewelry.

Brass

Brass, an alloy of copper and zinc, is quite malleable and resistant to corrosion. Some brass alloys have higher amounts of copper, which can distinctly change the color.

NuGold is an alloy that looks like brass. It is made of 88 percent copper and 12 percent zinc and is richer in color than standard brass.

Bronze

An alloy of copper and tin, bronze is easy to melt and cast. It is less susceptible to corrosion than copper, its parent metal. Bronze is slightly more orange/red in color than brass.

Copper

Copper, the first metal known to man, is malleable and can be worked both hot and cold. It conducts electricity very well and retains a high polish, though it is quite susceptible to oxidation from the natural atmosphere.

Lead

Lead was historically used in jewelry making, but due to the toxicity of the metal and the risk of contaminating other metals, it's wise to keep all lead out of your jewelry studio. The only time lead should be allowed in jewelry is in the alloy niello. Niello is a mixture of sterling silver, lead, and sulfur. It has a very soft, dark-gray color and can be used as inlay for surface design.

Nickel Silver

Nickel silver is 60 percent copper, 20 percent nickel, and 20 percent zinc. This alloy is used in jewelry making because it is relatively malleable and has good working properties. Its rich gray color is similar to white gold and it is very inexpensive. Since many people are allergic to nickel, it is not recommended for earring findings or for other jewelry that will be in contact with the skin, such as rings. Nickel can also be difficult to solder as it oxidizes quickly and this oxidation can be difficult to remove.

Niobium

Niobium is a soft, ductile metal that polishes well. Like aluminum, it can be anodized. Niobium can be cold connected but it cannot be soldered.

Pewter

Pewter has a very light gray color and is quite attractive when polished. It is great for making larger metal pieces, such as boxes and vessels. Pewter can be soldered with a very low-temperature solder. (This type of solder once contained lead, but now is made lead-free with tin.) Pewter soldering is different from silver soldering. You can use a soldering iron or a very low, warm flame from a torch. Pewter should be used separately from precious metals due to contamination issues.

Titanium

Grayish brown in color, titanium is a tough, ductile metal that is resistant to corrosion. Titanium is lightweight, but denser than aluminum. It cannot be soldered but can be cold connected.

Alloys

An alloy is a metal that is composed of two or more different metals. There are many reasons for creating metal alloys. Strength and durability top the list, but the ability to change the color of metal through alloying is also popular.

Sterling Silver

Sterling silver is 92.5 percent silver and 7.5 percent copper. Copper is added to the silver in its pure form (99.9 percent silver) for increased strength. This alloy was originally created so hollowware items and cutlery would have the strength to hold up for regular use, but now sterling silver is desirable for jewelry as well.

Argentium Silver

Argentium silver is an alloy that uses germanium in place of some of the copper used in the sterling silver alloy. The use of germanium causes argentium silver to be tarnish-resistant, firescale free, and to have higher ductility than traditional sterling silver.

Gold Alloys

Gold alloys are manufactured in many different karats, or alloy percentages (see table). The word "karat" specifically refers to the purity of the gold. Different gold suppliers have slightly different alloys for various karats and colors. To maintain consistency in the color and character of the metal you use, purchase the same alloy from the same supplier.

High-Karat Gold

In its pure form, gold is 24 karats. Throughout the ages and all over the world, jewelry has been made from pure gold because of its rich orange/yellow color. Of all the varieties of gold, 24-karat is the softest. 18-karat gold is available in many colors, easy to work with, and harder and more durable than 24-karat gold.

Low-Karat Gold

14- and 12-karat golds are duller in color than the higher karats and are relatively inexpensive in comparison. In the United States, low-karat gold is commonly used in high-production commercial jewelry due to its lower cost. European countries do not allow the use of 14- or 12-karat gold for jewelry.

Karat Gold	Percentage of Gold	European Marking
24	100	999
22	91.67	917
18	75	750
14	58.33	585
12	50	417

White Gold

White gold is an alloy of gold and nickel or palladium. White gold is whiter than platinum but darker than sterling silver. Because nickel is a harder metal than palladium, nickel white gold is more difficult to work with than palladium white gold. Furthermore, nickel white gold will give you problems with firescale, making cleanup much more difficult. Palladium white gold is a pleasure to work with. It is easy to form and leaves no firescale.

Yellow, Red & Green Gold

Yellow gold is an alloy of pure gold, silver, and copper. The more copper that is added to the alloy, the redder the metal becomes. The working properties of yellow gold and red gold vary with the percentages of the metals in the alloy. Green gold (photo, right) is made with pure gold, 30 to 40 percent silver, cadmium, and zinc. This alloy is quite malleable and easy to work with.

Japanese Alloys

The most well-known Japanese alloys are shakudo and shibuichi. Shakudo (photo, right) is 5 percent gold and 95 percent silver. It melts between 1968° and 1980°F (1075.6° and 1082.2°C). Shibuichi (photo, left) is 25 percent silver and 75 percent copper. It melts at 1775°F (968.3°C).

These metals are both quite malleable and have excellent working properties. They are often used in mokume gane and marriage of metal. They take a patina very well and can turn a rich, deep black. For this reason shakudo and shibuichi are popular in modern art jewelry.

Solders

Solders are alloys of precious metals. Solders have lower melting points than the specific metals they join. This allows solder to join the metals together without melting the metals themselves.

Silver Solder

Silver solder is an alloy of silver, copper, and zinc. Silver solder comes in different alloys with different melting temperatures. This allows jewelers to perform many different soldering operations on a single piece of work without melting the previous solder joint. The higher the melting point of the solder, the more silver there is in the alloy. The most common silver solders are: easy flow, easy, medium, hard, and IT. Silver solder is used not only for soldering silver, but also copper, brass, bronze, and nickel.

Silver Solder: Melting & Flow Temperatures

Type	Melting Point	Flow Point
Easy Flow	1170°F (632.2°C)	1270°F (687.8°C)
Easy	1260°F (682.2°C)	1325°F (718.3°C)
Medium	1335°F (723.9°C)	1390°F (754.4°C)
Hard	1365°F (779.4°C)	1450°F (787.8°C)
IT	1440°F (782.2°C)	1490°F (810°C)

Gold Solder

Gold solder comes in many karats, and in melting and flow temperatures that are similar to silver solders. Gold solders are generally made from a karat-gold alloy and fine silver, but this composition can differ based on the solder supplier. Often, cadmium is also added to the karat alloy to lower its melting point. Because of its considerable expense, gold solder should be used only to solder gold pieces unless you wish to use the color of the solder as a design element.

Bimetal

Bimetal is not an alloy, but deserves mention. This is a sheet metal with one side made of one metal and the other side made of a second metal. These metals are molecularly attached in layers. Most bimetal sheet is made of sterling silver and gold or sterling silver and copper. Bimetal sheet can be extremely useful for cutting costs and for utilizing the color properties of two different metals.

Gold Filled

The phrase "gold filled" means that a layer of gold has been soldered or otherwise mechanically adhered to a layer of a base metal, most commonly brass or silver. This metal is then drawn or flattened to a specific dimension. Although the gold-filled metal looks like a gold alloy, it is not one. Rather, it is simply a super thin layer of gold adhered to a base metal.

Ferrous Metals

Ferrous metals are metals that contain iron. These metals can be cold joined or welded. The use of ferrous metals in jewelry is unconventional but can be very interesting. One can utilize the unique properties of these metals in creative ways, such as allowing the metal to rust to achieve interesting colors and surface textures. Combining ferrous metals with precious metals through cold techniques can be attractive and can challenge the widely held notions of value.

Iron

Iron is very brittle in its pure form. It is a tough metal that is very prone to corrosion. The rust that results from oxidation can be used as in interesting surface coloring for jewelry, but it should be sealed in order to prevent the rust from getting on articles of clothing. Although iron can be cast, it cannot be bent, soldered, sawn, filed, or drilled.

Steel

Steel is an alloy of iron and carbon that is capable of being tempered (heat treated) to many different degrees of hardness. Steel is a malleable metal that can be treated to make it extremely tough. Its working qualities and ability to be tempered make it the best metal to use to make tools of all sorts.

Stainless Steel

Stainless steel is an alloy of steel, chromium, and nickel. There are several different alloys of stainless steel, which are made for different industrial applications. For most jewelry-making applications, it does not matter which stainless steel alloy is used. The biggest advantage of using stainless steel over mild steel is that stainless steel will not rust, has a lovely gray color, and is quite tough.

Mild Steel

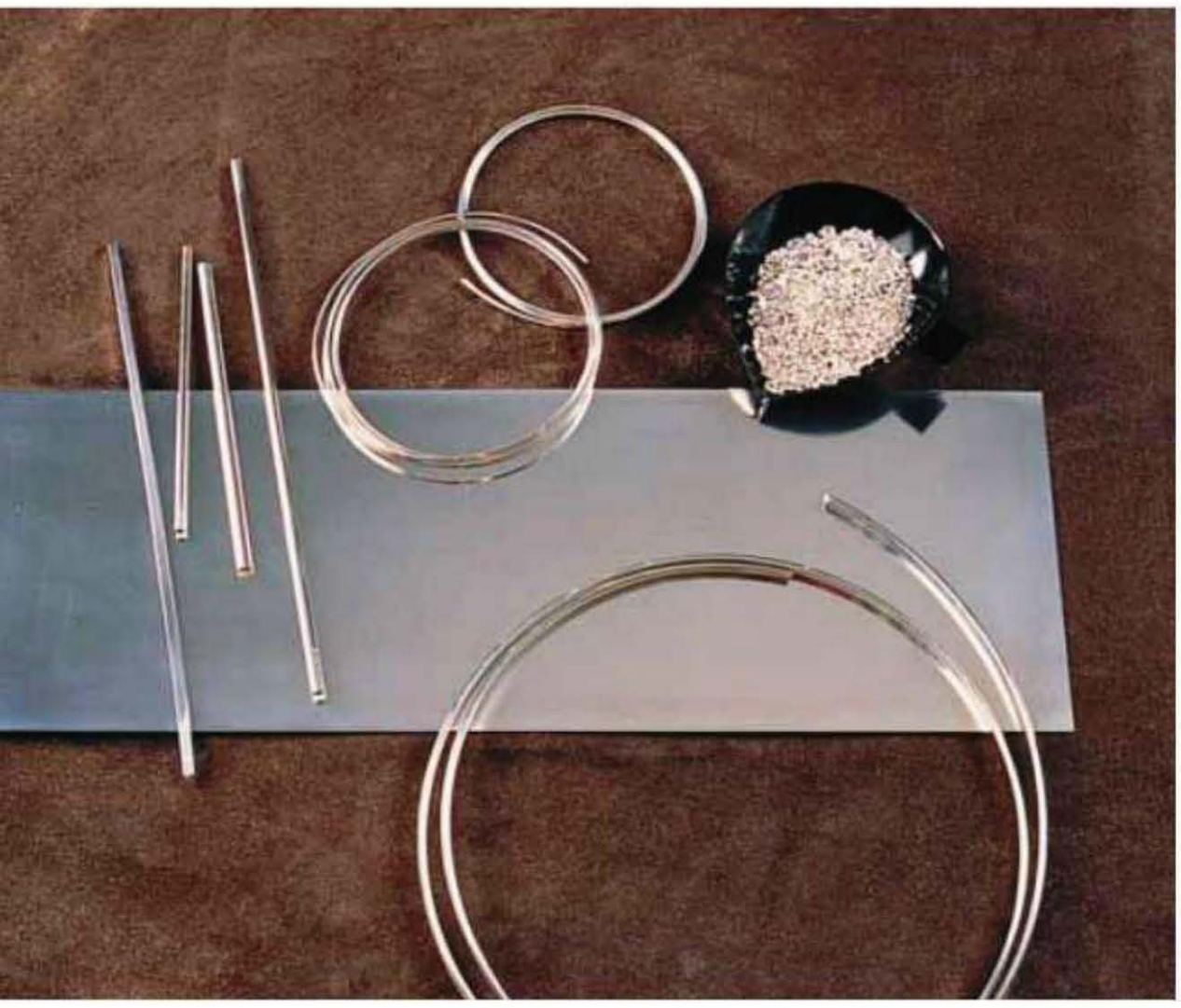
Mild steel is an alloy of iron and carbon that contains less carbon than many other alloys. It can be soldered with silver solder, but the bond is very weak. Mild steel can also be drilled, formed, filed, and sawn before being heat hardened (tempered). Mild steel is dark gray in color and will readily rust. It also comes in the form of tool steel, which can be used for making chasing, setting, and forming tools.

The Precious Metal Market

In addition to being bought as raw materials for jewelers, metals are bought and sold as commodities on the exchange markets. The price of precious metals changes daily, similar to the price of oil or a stock. (As a matter of fact, when the price of oil rises, the price of gold and silver rise, too, as more people turn from investing in oil to investing in other raw materials.) When you order precious metals from a supplier, the price quoted in the catalog is simply an estimate. Most companies price the materials on the day they ship your order.

Purchasing Metals

For ease in making jewelry, most nonferrous metals can be bought in many different forms, including sheet, wire, tubing, and grain. Different suppliers offer many different types of these popular metal forms. For example, you can buy tubing and wire with different contours, such as round, half round, square, and rectangular. Buying metal in pre-made forms saves time and energy, and the readily available shapes can spur your creativity.



Metal Gauge

Wire and sheet is often measured according to the American Wire Gauge (AWG) or Brown and Sharpe (B&S) measuring system. This system categorizes metals by gauge, which correlates to their thickness. Gauges are numbered inversely; the higher the number of the gauge, the thinner the metal. The Brown & Sharpe system is best used as a guide, as each metal supplier slightly varies the measurements of its gauges. Buying your metal from the same supplier will help your measurements remain consistent. Refer to the table below to find the measurement in millimeters for common metal gauges.

B&S Gauge Measurements

Gauge	Millimeters
2	6.544
4	5.189
6	4.115
8	3.264
10	2.588
12	2.053
14	1.628
16	1.291
18	1.024
20	0.812
22	0.644
24	0.511
26	0.405
28	0.321
30	0.255

Mining Ethics

All metals are originally mined. In order to mine the ore from the earth, deep pits are dug and the ore is often extracted by means of sulphuric acid in a process called leaching. This process and its consequences are extremely destructive to the environment. Some metal suppliers buy metal that has been freshly mined, while other suppliers use only recycled metal. Before purchasing metal, it is important for you to think about your options in this regard. Ask your supplier where they source their metal before deciding to purchase material from them.

Refining Metal

Many companies refine materials. This means that they accept scrap metal in all forms and separate the metals from the alloys. In essence, refiners "reclaim" the original materials and pay you a percentage of what the material is worth. Refining is an important part of responsibly working with metal. When you save your scraps and refine them, you are helping conserve a nonrenewable natural resource. Clearly, you can save the scrap material from sawing, filing, and sanding, but you can also refine the clothes you wear while working with precious metals, as well as the carpet on your studio floor. Anything that traps particles of metal can be sent to the refiner. Wait until you have a large amount of these items before sending them to the refiner. There is a base fee to refine metal, and you want to make sure the amount you get out of the scraps is larger than what you spend.

Tools

The tools required for setting up a new jewelry studio often depend on what you are making and how you are making it. The following are must-have tools for every jewelry studio; you may want more or less tools based on your individual needs.

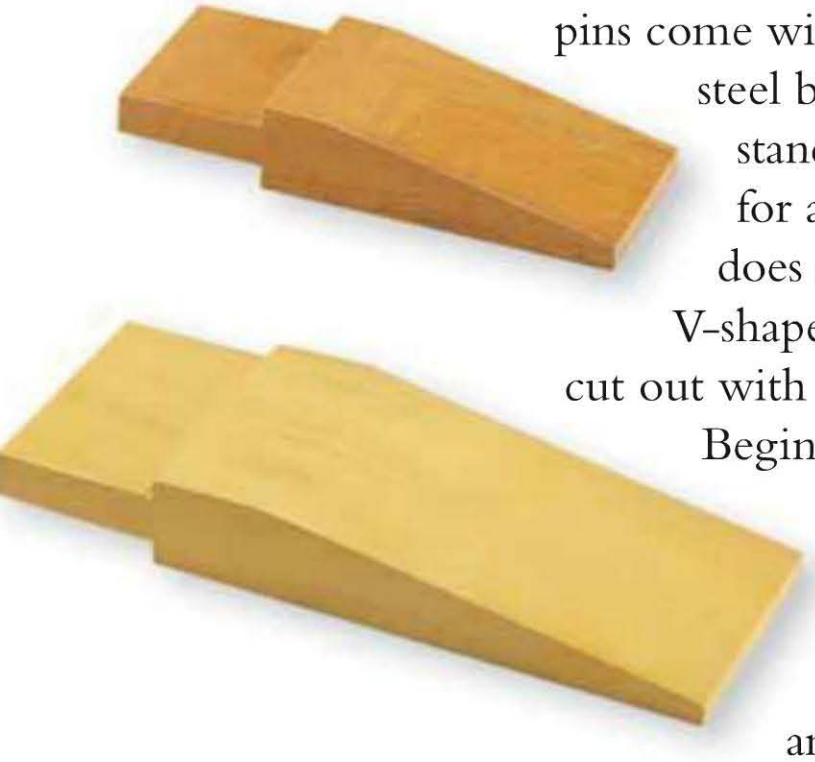
Work Surfaces

Jeweler's Bench

This is a worktable specifically designed for making jewelry. The height of a jeweler's bench is 36 inches (91.4 cm), whereas a typical worktable is 30 inches (76.2 cm) tall. It has drawers for holding tools and a tray that extends over your lap to collect filings and pieces of metal that drop while you're working. Although not completely necessary, a jeweler's bench is a convenient and worthwhile item to purchase or make. The height of the bench reduces back pain caused from bending over to see your work and it also places your work at eye level, giving you room to saw without bumping into your thigh.

Bench Pin

A bench pin is a work surface on which to saw metal. It allows easy manipulation of the saw and the metal to be cut. Commercial bench pins are sold in many styles and sizes. If you don't have a jeweler's bench with a slot for the bench pin, a portable bench pin is a good choice. It comes with a precut V-shaped slit for sawing, and has a C-clamp specifically designed to attach the bench pin to a tabletop. Some portable bench pins come with a built-in steel block, as well. A standard bench pin for a jeweler's bench does not have a precut V-shaped slit. It must be cut out with a saw or a jigsaw. Beginning jewelers can create their own bench pin out of a plain piece of smooth wood and a construction C-clamp.



Steel Bench Block

A steel bench block is an indispensable work surface that provides even and strong support for hammering. Most steel blocks are 2 x 2 inches (5.1 x 5.1 cm) or 4 x 4 inches (10.2 x 10.2 cm). The block has a highly polished surface that should be treated with care. Any marks on the steel block will be transferred to the metal when it's hammered.

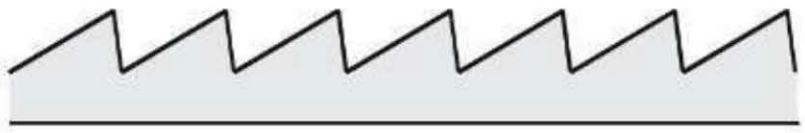
Cutting Tools

Jeweler's Saw Frame

A basic jeweler's saw frame with a wooden handle and a metal jaw will work well for nearly all jewelers. The height of the frame adjusts to fit different blade lengths and tensions. The "throat size" of a jeweler's saw is the measurement from the blade to the back of the frame. The most common and most practical throat sizes are 60 mm and 100 mm. Larger or smaller throats may be advantageous for larger or smaller metal work. Use a frame size that is most comfortable for your working methods.

Saw Blades

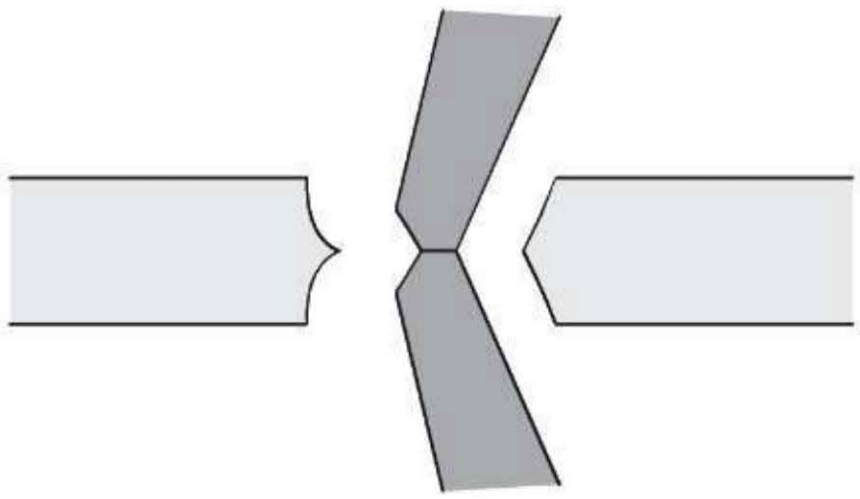
Blades for jeweler's saws are available in many brands and sizes. Always invest in high-quality blades. Less expensive blades are of inferior quality, break more easily, and are not worth the money you save. A good, basic blade size is 3/0. This will work for almost any jewelry application, even for professionals. Sizes 1/0 and 2/0 are also useful, though you sometimes may use a very small blade such as a 6/0 for particular work, such as sawing small tubing and thin metal. Beeswax is an effective blade lubricant that makes sawing smoother and easier.



Close-up of saw blade teeth

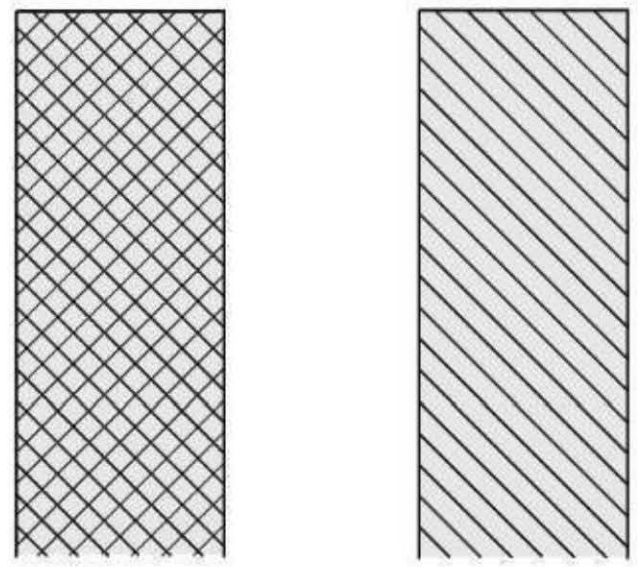
Snips

Snips are used for cutting wire. They are specifically made for jewelers and are smaller than those you might find at the hardware store. As shown in the illustration below, some snips are made to cut one side of the wire flat and the other side at an angle. These are useful when you need to cut a flat end of wire and don't want to have to file or sand after snipping. When purchasing snips, make sure to note the maximum wire thickness the snips are made to cut.



Files

Files are used to remove metal. Files remove more metal than sandpaper, but less than a jeweler's saw. All files remove metal on the forward stroke. The backward stroke simply scratches the material. A coarser file removes more metal than a fine-cut file. Similarly, a crosscut file removes more metal than a single-cut file.



Crosscut file

Single-cut file

Needle Files

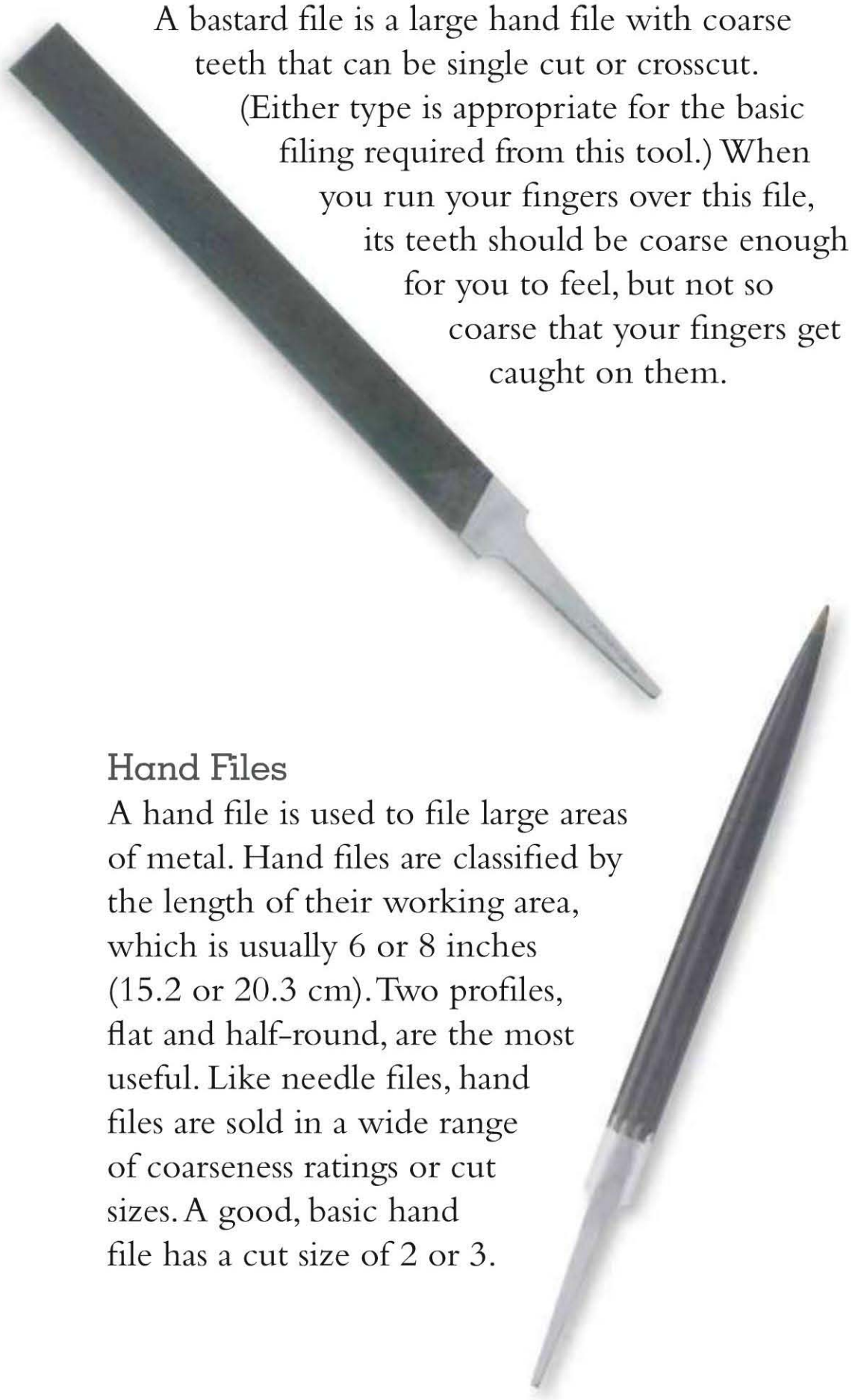
Needle files are short, usually only 6 inches (15.2 cm) in total length, and much narrower than hand files. They are available in many shapes and have teeth in various grits. A basic set of needle files includes a barrette file, a half-round file, a round file, a square file, a flat file, and a triangular file. A medium- to fine-cut tooth is best for beginning jewelers.

Riffler Files

These 6-inch (15.2 cm) files are similar to needle files, but the cutting end of riffler files are curved to fit into recessed or hard-to-reach places.

Bastard Files

A bastard file is a large hand file with coarse teeth that can be single cut or crosscut. (Either type is appropriate for the basic filing required from this tool.) When you run your fingers over this file, its teeth should be coarse enough for you to feel, but not so coarse that your fingers get caught on them.



Hand Files

A hand file is used to file large areas of metal. Hand files are classified by the length of their working area, which is usually 6 or 8 inches (15.2 or 20.3 cm). Two profiles, flat and half-round, are the most useful. Like needle files, hand files are sold in a wide range of coarseness ratings or cut sizes. A good, basic hand file has a cut size of 2 or 3.

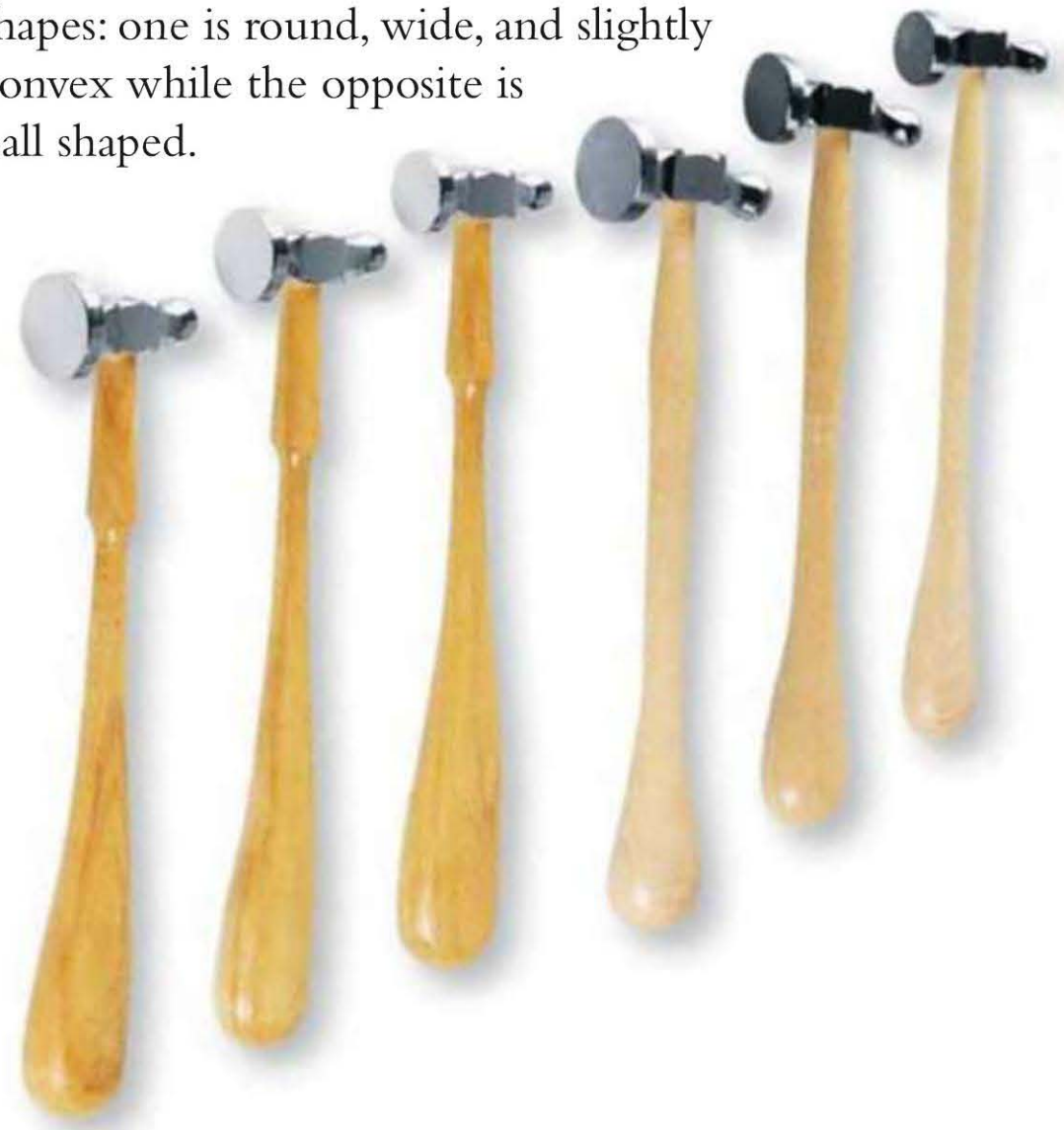
Hand-File Assembly

Hand files are sold without handles, which are purchased separately. To insert the file into the handle and make a good strong fit, heat the end of the file tang and burn it into the wooden handle. Strengthen this fit by adding a few drops of epoxy to hold the handle in place. Alternately, as shown in the photo, some plastic and wooden handles come with precut grooves into which you can screw the file tang.

Hammers

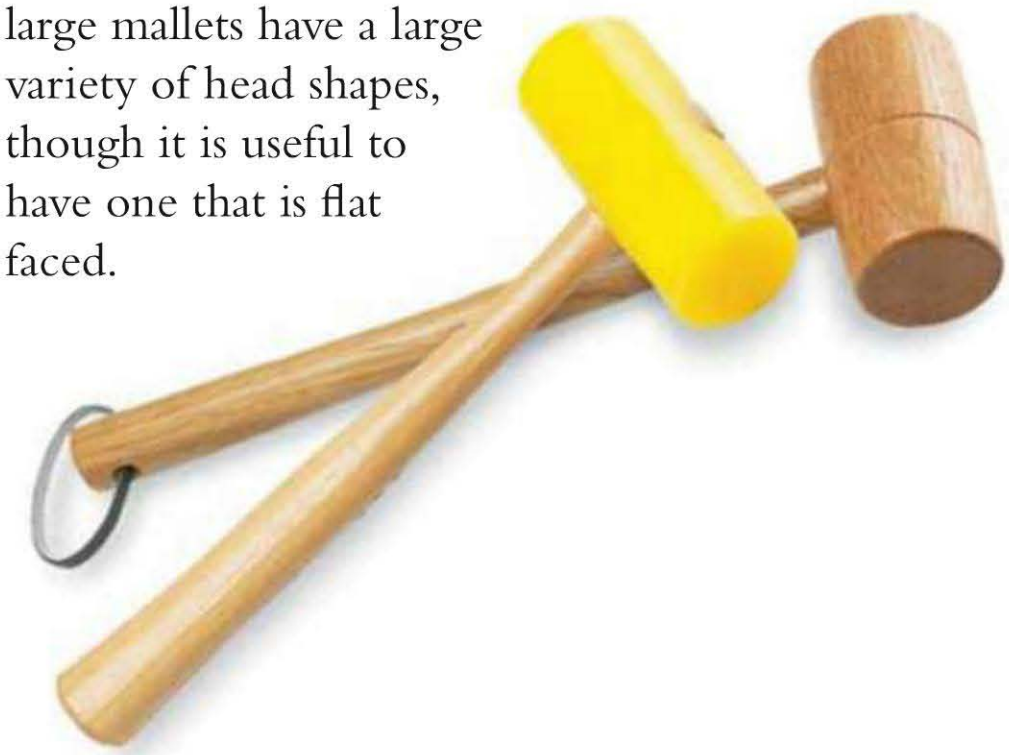
Chasing Hammer

Although the chasing hammer was specifically designed for the technique of chasing, it is the most versatile hammer for jewelry making because it is appropriately weighted to give a gentle but firm blow. The head of a chasing hammer is made of polished steel. It has two faces with different shapes: one is round, wide, and slightly convex while the opposite is ball shaped.



Rawhide, Wooden & Plastic Hammers

Rawhide, wooden, and plastic hammers are used to form metal without distorting its surface. They shape metal without stretching it. These large mallets have a large variety of head shapes, though it is useful to have one that is flat faced.



Forming Tools

Pliers

Jeweler's pliers are small, and their jaws are expressly designed for creating jewelry and using small parts. The jaws of flat-nose pliers (top) have flat and tapered exterior surfaces and flush interior surfaces. They are useful for firmly gripping objects, such as one side of a jump ring. Chain-nose pliers (center) are round on the exterior of the jaw, flat on the interior, and taper. Use them to reach into small places. Fully rounded and tapered jaws make round-nose pliers (bottom) an excellent tool for forming wire. Often, round-nose pliers come with slightly different shapes on the cones of the two round jaws. Simply use your file to make these shapes the same, then sand and polish.

Vise

A vise is a tool with jaws that hold items steady. Its jaws can be smooth or crosshatched for better gripping. If the jaws are crosshatched, place pieces of copper or leather in the jaws to prevent metal from becoming marred. Vises come in many sizes for different uses.

Mandrels

A mandrel is a form, most often cylindrical, around which wire is wrapped or thin sheet metal is shaped or hammered. Some mandrels are tapered while others have a consistent diameter for their entire length. You can buy mandrels specifically designed for forming rings (right), bracelets (below), and jump rings (bottom) or you can adapt scores of other objects, such as tubing, dowels, pencils, and pipes, into mandrels.

Dapping Block

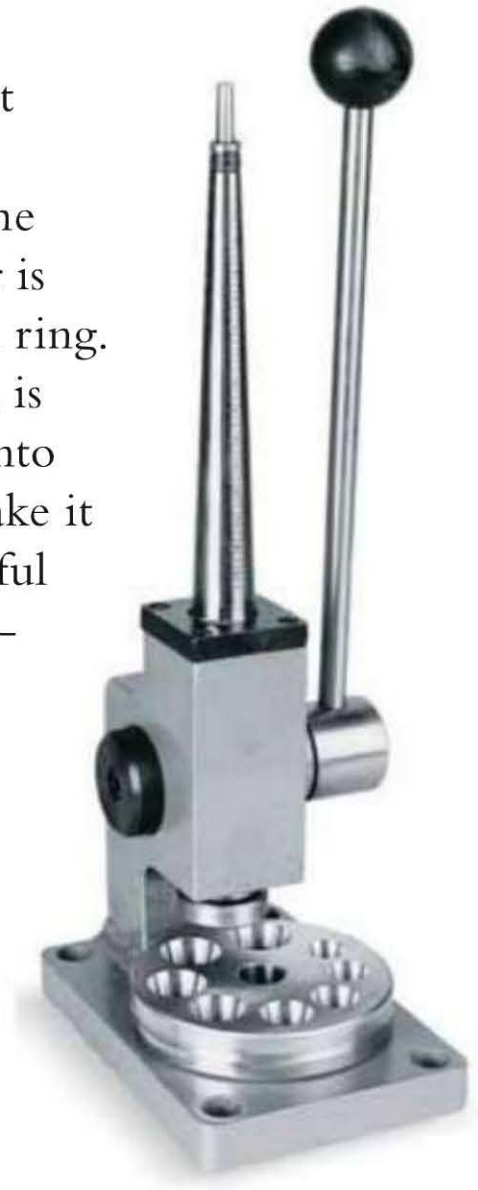
A dapping block is a steel or wooden block with depressions in its surface into which metal is formed. Dapping blocks have a series of depressions of varying sizes. Most are half spheres, but other shapes such as ovals can be custom carved into a block.

Dapping Punches

Dapping punches are used to push metal into the depressions of a dapping block. Different size punches fit different depressions. Made of either wood or steel, the punches have one round or curved end and one flat end on which to hammer. When hammering dapping punches, be sure to use a hammer made of any material other than steel. Steel hammers will eventually deform the ends of dapping punches. If you need a heavy hammer to use when dapping, a hammer with a brass head is a good choice.

Ring Stretcher

A ring stretcher is a tool that can make a band ring larger or smaller. The top part of the tool expands when the lever is depressed to slowly stretch a ring. The bottom part of the tool is used for depressing a band into the open tapered hole to make it smaller. This tool is very useful when making rings of different sizes. An annealed band can often be stretched up to two to three sizes without adding metal.



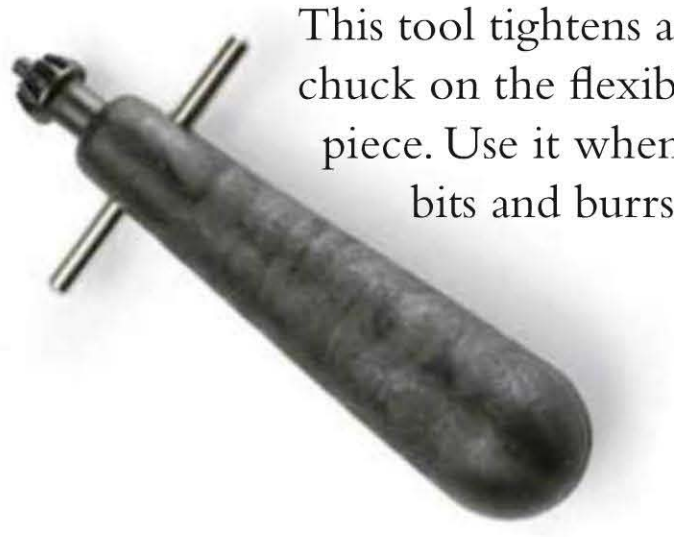
The Flexible Shaft & Its Attachments

Flexible Shaft

A very wise investment, the flexible shaft machine is an important tool because it accepts most types of drill bits and many attachments necessary for making jewelry. The flexible shaft (or "flex shaft" as it is commonly known) consists of a mounted motor and a handpiece connected by a long, flexible cord. A foot pedal controls the speed of the attachment. This action is similar to operating a sewing machine or pressing the gas pedal in a car.

Some people use a high-speed rotary tool in place of a flex shaft. However, this is not recommended because of how the tool is held in your hand. Over a long period of time, the flex shaft is much better for the health of your hands than a rotary tool. The ease of use and ergonomics of the flex shaft far outweigh the money saved on a cheaper rotary tool.

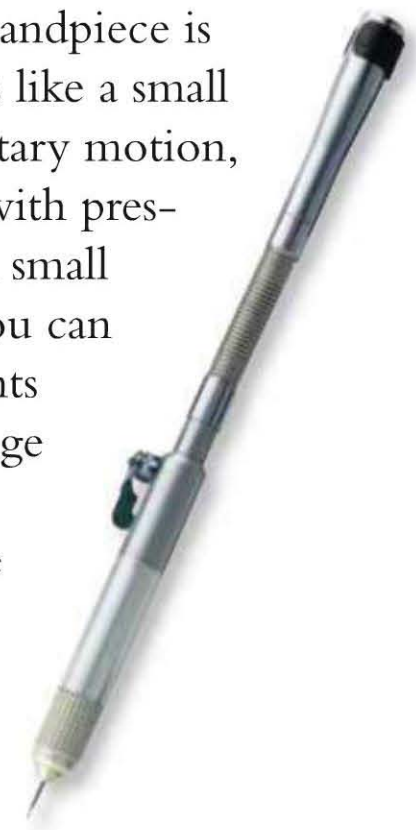
Chuck Key



This tool tightens and loosens the chuck on the flexible shaft's handpiece. Use it when switching drill bits and burrs.

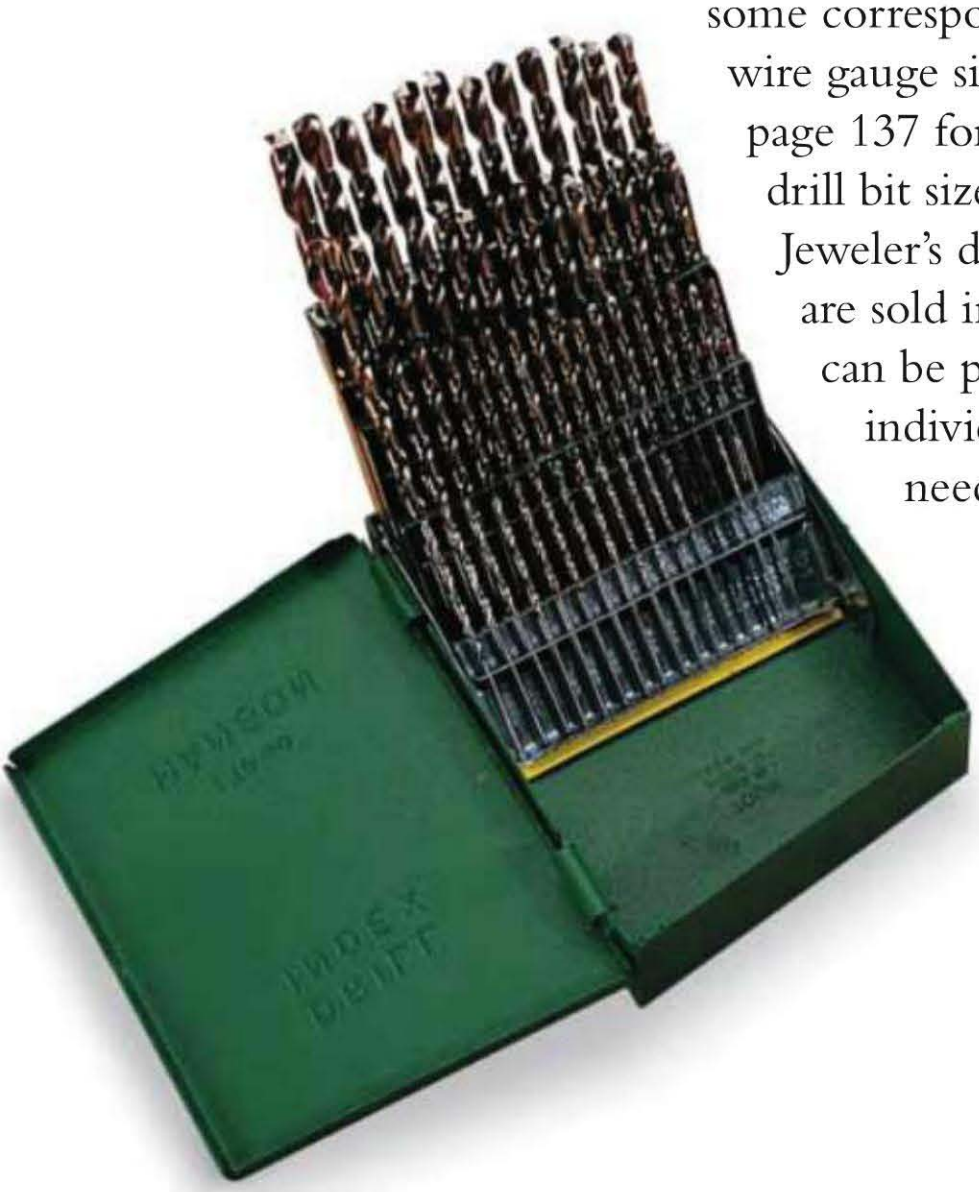
Flexible Shaft Handpieces

The handpiece on a flexible shaft is removable. Simply pull it off the end of the shaft. You can replace a chuck-style handpiece with a variety of other handpieces. Most often, a hammer handpiece or a quick-change handpiece is used. A hammer handpiece acts like a small hammer: instead of having a rotary motion, its motion goes up and down with pressure. This handpiece has several small attachments for the end, and you can alter the commercial attachments to fit your needs. A quick-change handpiece (photo, right) has a lever that allows you to remove attachments instead of a chuck and chuck key. This works great for attachments that are all the same size and can save you lots of time. However, a quick-change handpiece will not accept tiny drill bits, so special bits must be used.



Drill Bits

Jeweler's drill bits are specifically designed for drilling metal. They are made of high carbon steel that resists breakage. The chuck in the flexible shaft machine is sized to accommodate the smaller-than-average size of these bits. Most bits are measured by their diameter in millimeters, but some correspond to wire gauge sizes. (See page 137 for a handy drill bit size chart.) Jeweler's drill bits are sold in sets or can be purchased individually as needed.



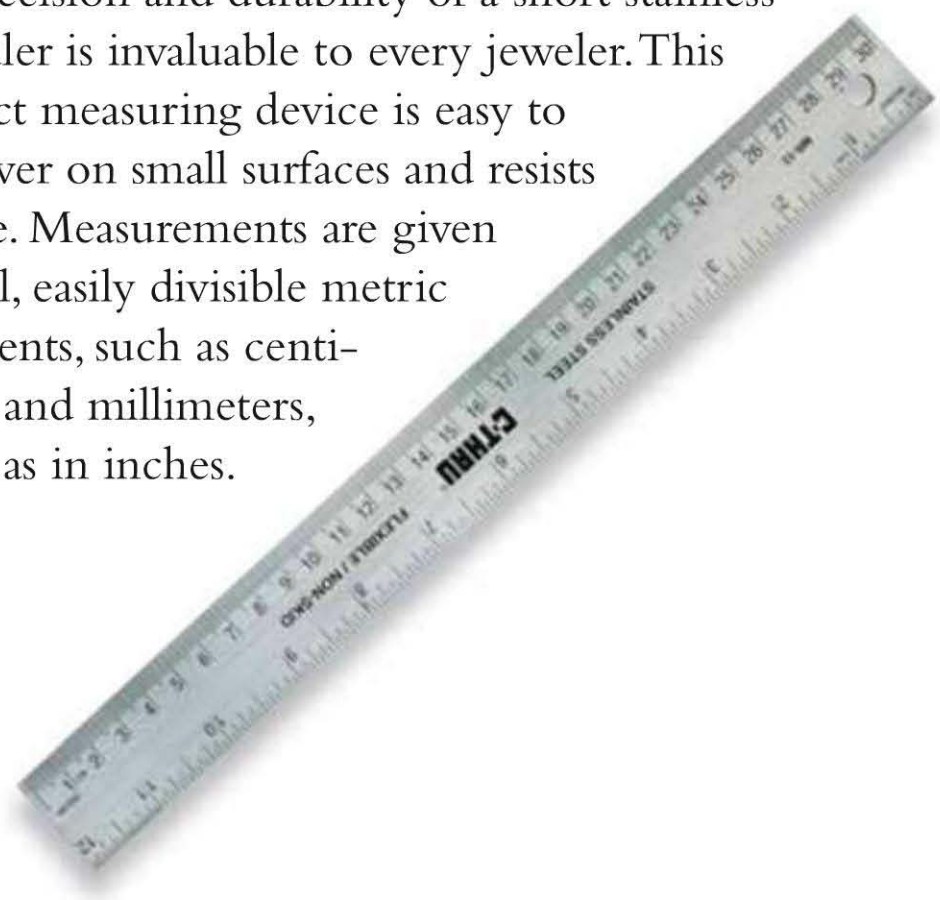
Burrs

Burrs are attachments used with rotary tools. Different types of burrs are inserted in the end of a flexible shaft to perform different jobs, such as cutting, setting, and carving. A wide variety of burrs are available to make accomplishing key elements of your work easier. You can buy them in handy sets or purchase them individually.

Measuring & Marking Tools

Stainless Steel Ruler

The precision and durability of a short stainless steel ruler is invaluable to every jeweler. This compact measuring device is easy to maneuver on small surfaces and resists damage. Measurements are given in small, easily divisible metric increments, such as centimeters and millimeters, as well as in inches.



Calipers

Calipers are an instrument for taking exact measurements. Their adjustable jaws are particularly useful for measuring thicknesses and internal or external diameters. Calipers are essential for most types of stone setting. They can also be locked at a specific length to provide consistent measurements. Some jewelers like using digital calipers (right), although others are more comfortable using analog ones.

Dividers

Dividers are a two-legged device that opens up to different, measurable lengths and are used for measuring and marking distances. Similar to a protractor, they are very useful for plotting equal distances on circles, for running along the straight edge of a piece of metal to mark a strip, and for creating circles of specific diameters. The legs open and close by twisting the knob, and the distance can be measured on a steel ruler or with calipers. Dividers are also useful for laying out round jewelry designs such as rings, necklaces, and bracelets. You can also use dividers to separate circles into even arc lengths, which is useful when marking equal distances on a ring.

Scribe

A scribe is a pointed tool used to make marks on metal. You'll use a scribe to draw points and lines or to transfer designs.

Center Punch

Use a center punch to make a slight indentation on a metal surface prior to drilling. This preliminary step helps hold the drill bit in the desired location so the hole is made precisely where you want it. An automatic center punch (top) does not require the use of a hammer to make an indention. A manual center punch (bottom) is used with a hammer.

Made-to-Order Tools

You can often make your own tools out of items you wouldn't normally consider, such as a nail or an old nail punch. Use the techniques described on the following pages to create a variety of tools for your individual needs and style.

Custom Chasing Tools

Adding designs to your jewelry with truly unique tools is deeply satisfying. Once you know how to make your own chasing tools, you can create an infinite variety of stamps and shapes with designs as ornate or delicate as you like.

PROCESS

Note: *Tool steel is sold in water-quenching and oil-quenching varieties. Be certain you know the type of tool steel you are using before you harden and temper your tools.*

CUT a 3- to 4-inch-long (7.6 to 10.2 cm) piece of tool steel with a jeweler's saw.

Some jeweler's prefer extremely short chasing tools that are approximately 2 inches (5.1 cm) long. A comfortable fit depends on the size of your hands and how you like to hold the tool. Experiment to see what length works for you.

CARVE a design or shape into one end of the tool steel with needle files.

Since tool steel is sold fully annealed, the carving should be very easy, although it may take time to carve the exact design you want.

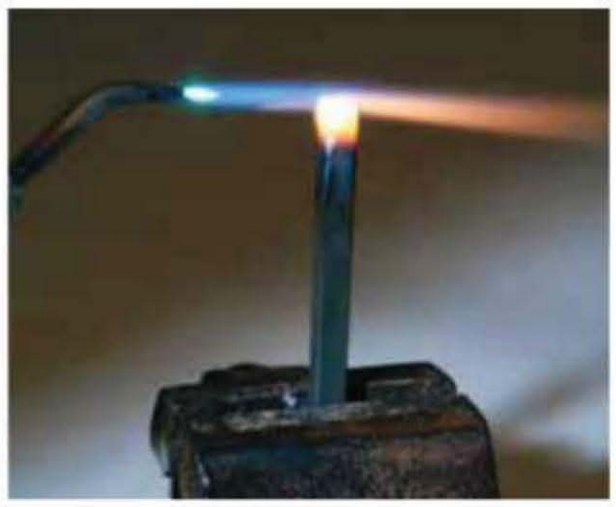
Using steel burrs may also be necessary, depending upon the design. For example, to make an O shape, you would carve the perimeter of the O with a needle file, and then remove the interior metal of the O with a round burr.

SAND the carved design to a 400-grit finish.

POLISH the sanded tip to a rouge shine.

Polishing the tool will help it glide through the metal when you use it.

HEAT the carved tip of the tool with your torch until it is red/orange hot.



To keep from burning your fingers, you will need to hold the tool in a vise or heavy pliers.

QUENCH the whole tool immediately in water or oil (depending on the kind of tool steel you have) until it is cool.

This hardens the steel and makes it brittle.

DRY the tool.

REHEAT the tip of the tool until the metal begins to appear slightly blue and cornhusk yellow. This happens very fast.

QUENCH the whole tool immediately.

This tempers the steel, meaning the brittleness of the metal has been removed, but the tool is now hard enough to retain its design after repeated hammering.

HEAT the opposite (hammering) end of the tool with your torch until it is red/orange hot.

QUENCH the whole tool immediately and dry it.

REHEAT the hammering end of the tool until the metal appears slightly blue and cornhusk yellow.

QUENCH the whole tool immediately and repolish both ends if desired.

Decorating Custom Tools

The pleasure you'll receive from using decorated tools is immense, well worth the extra time and effort.

PROCESS

Note: *You might need someone else to hold the torch as you twist the metal. The steel will only move when it's red hot, so the heat must be constantly applied.*

CARVE the end of the tool into the shape you desire.

You can also carve decorative designs on the shaft of the tool with needle files. This is an especially good option when using round tool-steel stock.

PLACE the tool vertically in a vise.

HEAT the tool where you want to twist until it is red hot.

GRASP the tool with heavy pliers and begin twisting, making sure to keep the tool in a straight line, perpendicular to the jaws of the vise.

TWIST the red-hot steel in one direction and then back in the other direction for a very fancy twist.

COOL the tool, and then harden and temper its ends.

Tip

Mass-produced stamps and chasing tools bought from jewelry suppliers aren't perfectly prepared for immediate use. To make them most effective, you'll need to slightly alter them by filing or sanding. Polish both ends of the chasing tools, and they'll be ready to go.

Altering Tools

You can alter any purchased or old tools to suit your needs or just to save some money. Tools can be filed, shaped, sawn off, polished, or otherwise manipulated by using the techniques described in Made-to-Order Tools, beginning on page 25. When purchasing tools, it can be difficult to impossible to tell what type of steel is used, so when altering tools, you often have to remain flexible and go with the flow.

Before you saw or file heat-treated steel, make sure to anneal it first. You'll know that the steel needs to be annealed when you begin to file and the metal won't allow you to work. In order to anneal steel, heat the metal to a red-hot glow, and then let it air cool. This works for most purchased steel tools, but sometimes you're simply out of luck and cannot anneal the metal. Similarly, you can usually harden and temper purchased steel tools, but sometimes the metal isn't suited to those applications and will always remain soft.

Tool Maintenance & Care

All of the tools in your studio need regular maintenance and care in order for them to last a long time and remain in good working order.

Mechanical Tools

For every mechanical tool you purchase, make sure to hold onto the owner's manual. This is the best reference for upkeep of your tools. Keep in mind that regular maintenance is required. Make it an annual assignment to go through your tool manuals and make certain that you're properly taking care of your machinery. This is very important, not only for the life of your tools, but also for your own safety. If you do not have an owner's manual, you can always call the manufacturer or supplier of the tool and inquire how to maintain it.

Hand Tools

- Regularly oil all steel tools to prevent them from rusting. Carefully wipe down all tools with a soft rag and a small amount of lubricating oil. Never use linseed oil in a jewelry studio as it can self combust.

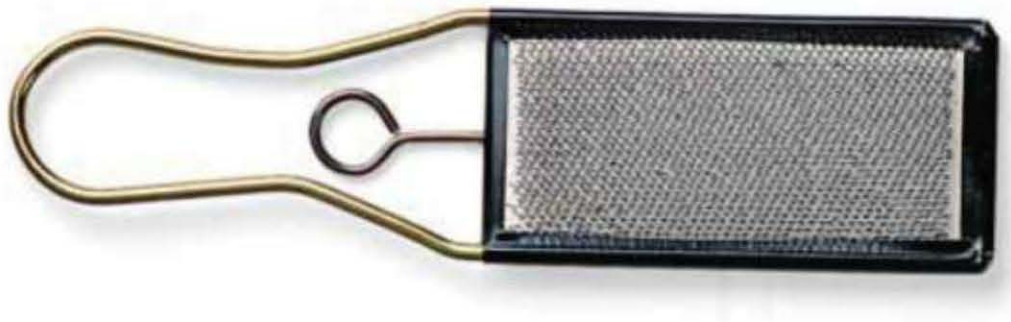
- Soak steel hammers upside down in a container of motor oil for a few days. This allows wooden handles to soak up oil, expand, and keep their firm grip on the hammerhead.

- Some jewelers store their steel tools in rags that are lightly soaked with oil to prevent them from rusting. This can be advantageous if you live or work in a damp area.

- You can often oil a rusted tool to remove the residue. If the rust is super heavy and thick, wear a mask and sand the rust off with a flexible shaft and some 400- or 600-grit sandpaper, and then oil the tool.

- If a file rusts, either soak it in oil; clean it with a file card (a brush that cleans particles out of file teeth, see photo below) and wipe with a soft rag; or simply purchase a replacement file.

- Tools such as steel dapping punches, steel bench blocks, burnishers, and setting tools should be polished to a fine sheen every few years or more often, as needed.



Design & Layout

Coming up with new jewelry designs is exciting, but in order to fully and efficiently realize your ideas, advance planning is advised. Thoughtful preparation helps you maximize your materials and minimize headaches.

Inspiration

Inspiration for jewelry can come from anywhere and everywhere. Look at the world around you. Investigate the minuscule. Make drawings (even if you think you're bad at drawing). Think about your life stories. Translate objects into metal, such as making a metal wine glass or a metal leaf. Collect items you find on the ground. Think about alternative materials. Look through picture books on unrelated subjects, such as architecture, history, and science. You get the idea. The main goal is to make something that is unique and authentic. Don't copy someone else; strive to be original and true.

Transferring a Design

Once you have drawn a design on paper, you'll need to transfer the design onto sheet metal to give you guidelines to follow with your saw. Before transferring any design, consider the surface space of the sheet and determine how to conserve as much metal as possible. For instance, don't place a design in the center of a metal sheet; instead, place it near the edge or corner of the metal. Often, you can use the straight lines of the metal edges to save yourself some sawing.

Using Graphite Transfer Paper

If your design is geometric, you can often use metal rulers, plastic templates, and a scribe to transfer shapes. If the design is more complex, or if it is a looser, more organic form, it's best to use graphite transfer paper.

PROCESS

PHOTOCOPY a design template or draw a design on paper.

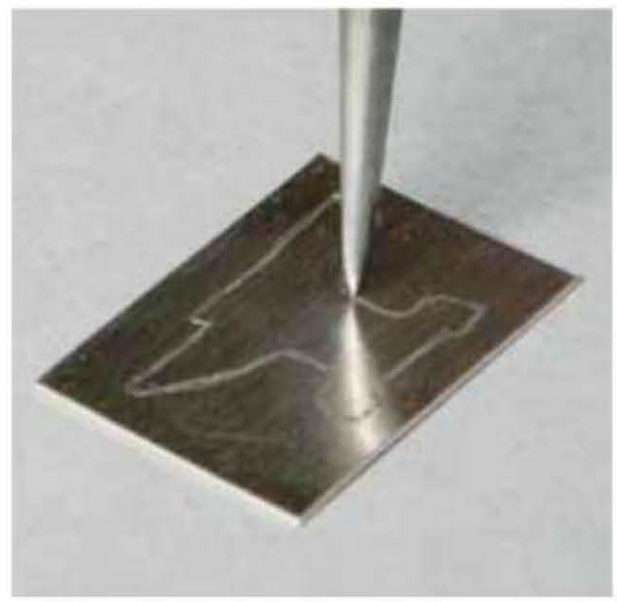
INSERT a piece of transfer paper between the design and the sheet metal with the graphite-coated side facing the metal.

OPTION: Tape the transfer paper down so it won't move around on the metal.

TRACE firmly over the design on the paper with a pencil or scribe.

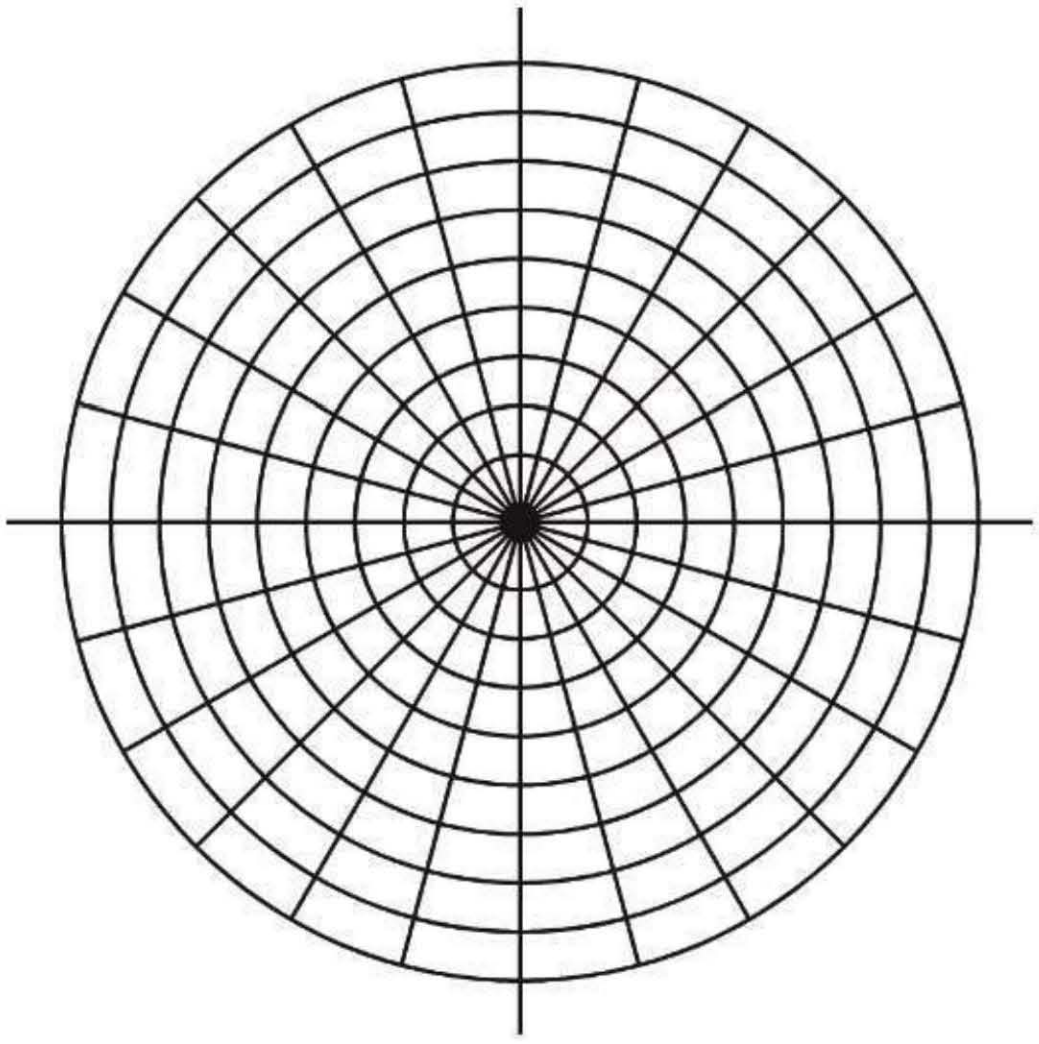
REMOVE the graphite transfer paper and the paper design from the metal.

TRACE back over the transferred design on the metal with a scribe to make sure the lines won't rub off as you work (see photo).



Circle Dividing Template

Use the template below for laying out a design and marking even spaces around a circle. Lay a metal circle or ring on top of the same size circle on the template, and mark the metal with a scribe. If desired, photocopy and laminate this template so it is durable and easily accessible.



New Tool

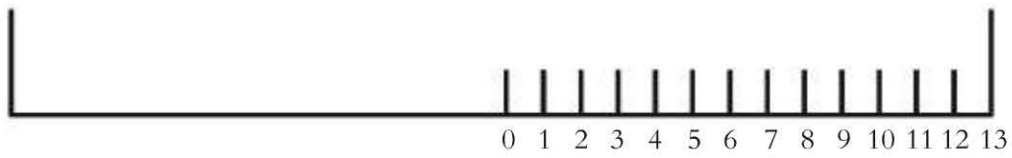
Templates are available for all kinds of tracing and measuring. They come in many shapes and sizes and are great to use in layout and design. Templates are made from both metal and plastic and can be purchased at art and craft stores.

Sizing

Ring Bands

If you're using fairly thin metal sheet stock, such as 24 or 26 gauge, use the template below to measure the length of metal needed for a specific size ring. If you're using thick stock for a band, you must add the thickness of the stock to the total length of metal required for the ring size. This will give you the approximate length of metal needed to bend the ring in a circle. See page 139 for a detailed chart on determining the lengths of ring blanks.

Ring Sizing Template



Tip

When deciding the width of a ring, keep in mind that there is a limited amount of space on the finger, and design the ring accordingly for comfort.

Necklaces

Necklaces can be made in a variety of sizes. For adults, the total length usually starts at 15 inches (38.1 cm) for a choker and can increase in length from there. The inside diameter of a stiff necklace usually begins at 5½ inches (14 cm). You can use a protractor and compass to layout this kind of necklace design. The templates on page 140 are very useful when planning necklace designs.

Bracelets

Bracelets for adults begin at 6 inches (15.2 cm) in circumference. The standard length for a chain-type bracelet is 7½ inches (19.1 cm). A cuff can vary in length from 6 to 8 inches (15.2 to 20.3 cm).

Bangle Sizes

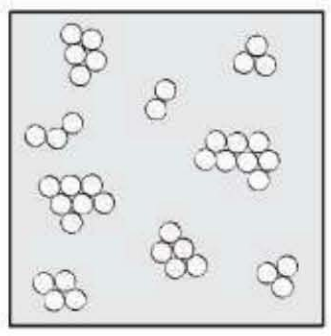
Size	Circumference
Small	7 inches (17.8 cm)
Medium	7¾ inches (19.7 cm)
Large	8½ inches (21.6 cm)

Fabrication Basics

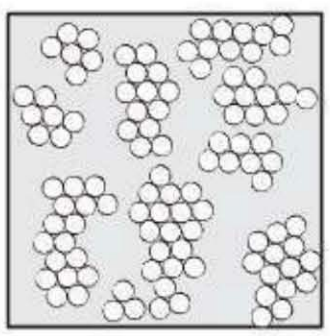
Understanding a bit of material science—such as how metal is structured and how it reacts to force and heat—increases your technical abilities and benefits your jewelry making. Fundamental operations that can be applied to metal are also covered here.

Metal Structure

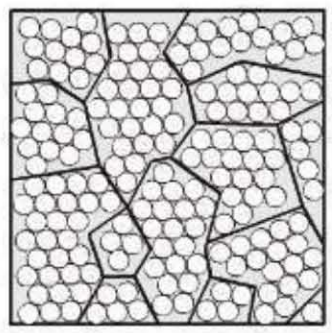
Each metal has its own crystalline structure. When metal is worked, this crystalline structure becomes deformed. Work hardening occurs when metal has been stressed in some way, such as through hammering or bending. Work hardening actually makes the metal harder by pushing the atoms in the crystalline structure closer together.



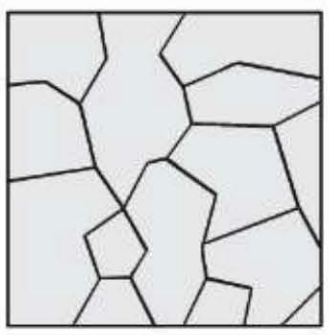
Atoms of molten metal



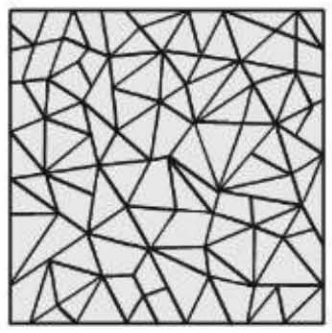
Atoms coming together as metal cools



Cooled metal (boundary lines are crystal definition)



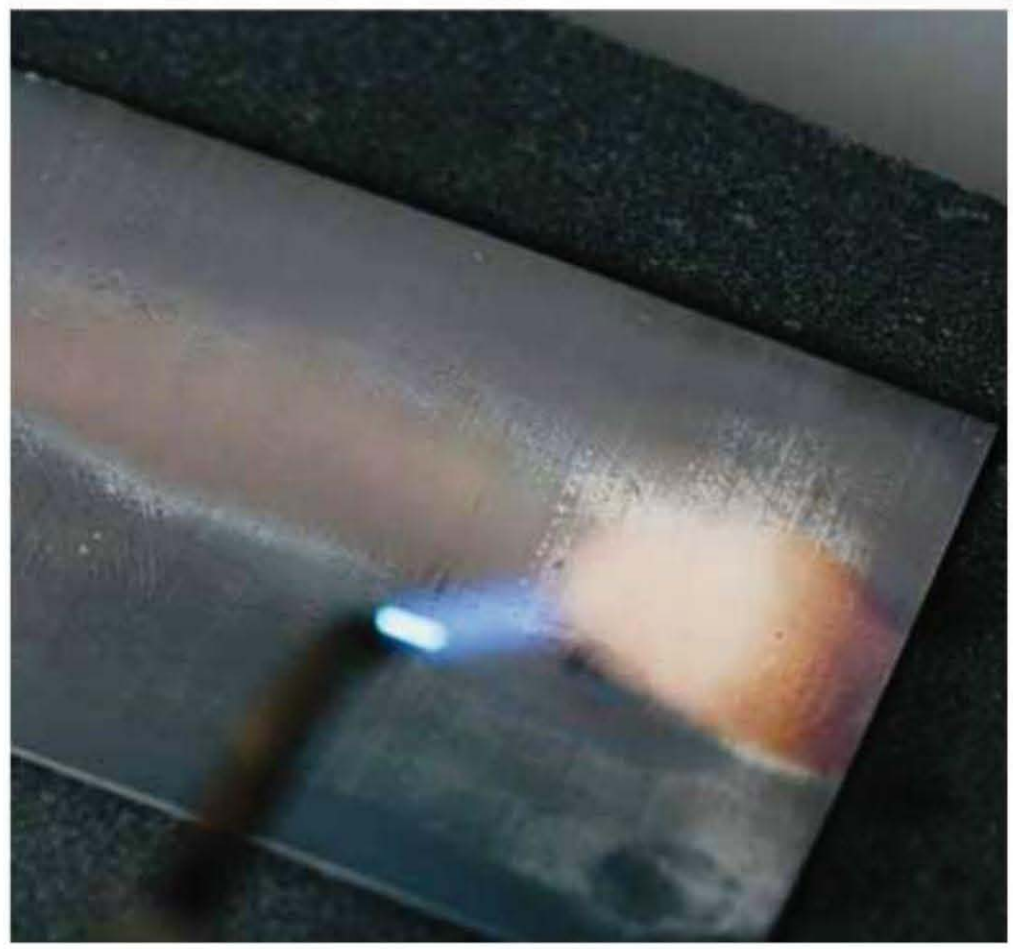
Crystal structure of annealed metal



Crystal structure of work hardened metal

Annealing

Annealing is a process that softens metal by applying heat. Heat reorganizes the atoms in the crystalline structure of the metal. Different metals anneal at different temperatures. The temperature indicator for annealing is the color of the metal when heated. Some metals must be quenched (placed into cold water when hot) to fully anneal, while others must air cool. To anneal most metals other than steel, heat the metal to a dull red color, then quench as soon as the redness disappears. The redness usually disappears by the time you are able to get the metal to the water with your tongs. To anneal steel, heat the metal to a dull red, then let it air cool.



Work Hardening

After soldering, metals are usually annealed. This can be undesirable for some projects, especially when there is no ready way to work harden the metal. Small wires, such as earring posts, will harden if gently twisted with pliers. In other situations where metal needs to be hardened but there is no easy way, such as a hollow formed bracelet, place the piece in a preheated oven [approximately 536°F (280°C)] for two-and-one-half hours to increase its strength. This process is called age hardening. Argentium silver has excellent age hardening capabilities, while sterling silver hardens best by work hardening.

Metal Features

Metal	Symbol	Melting Point	Specific Gravity*
Aluminum	Al	1220°F (660°C)	2.7
Argentium Silver	Arg Ag	1610°F (877°C)	10.41
Brass	70/30 Brass	1750°F (954°C)	8.5
Bronze	Bz	1886°F (1030°C)	8.7
Copper	Cu	1981°F (1083°C)	8.96
Gold	Au	1945°F (1063°C)	19.2
Iron	Fe	2802°F (1539°C)	7.87
Nickel	Ni	2651°F (1453°C)	8.9
Niobium	Nb	4474°F (2468°C)	8.57
Palladium	Pd	2829°F (1555°C)	12.0
Platinum	Pt	3224°F (1773°C)	21.5
Rhodium	Rh	3571°F (1966°C)	12.4
Silver	Ag	1761°F (960.5°C)	10.5
Sterling Silver	.925	1640°F (893°C)	10.41
Titanium	Ti	3047°F (1675°C)	4.5

**Specific Gravity*

Specific gravity is the ratio of the density of a given solid or liquid substance to the density of water at a specific temperature and pressure. Substances with a specific gravity greater than one are denser than water and will sink in it. Those with a specific gravity of less than one are less dense than water and will float on it.

Firescale

Firescale is an oxide of copper that appears on sterling silver and gold alloys. After heating the metal, firescale materializes as a reddish-purple stain on the surface. The longer metal is heated, the more likely that firescale will appear. After multiple soldering operations on the same piece, you can expect to deal with it.

Since firescale is difficult to remove, it is one of the most annoying problems in metalsmithing. The best way to remove it is to sand it off. This can be a laborious process, but it must be done to make good jewelry.

Inhibiting Firescale

Some jewelers coat an entire silver piece in a mixture of borax and alcohol to prevent firescale, while others use commercial formulas. The truth is, if you solder a lot with sterling silver, firescale cannot be stopped. To completely avoid firescale, try using argentium silver, an alternative alloy to sterling silver.

PROCESS

COAT the entire metal piece in a solution of boric acid and alcohol.

BURN off the alcohol with a torch.

FLUX and solder the metal as usual.

Depletion Gilding

This process is also known as "raising fine silver" or "raising fine gold." In essence, depletion gilding brings the pure metal in a silver or gold alloy to the surface, creating a fine silver or gold top layer.

Depletion Gilding

Use this process as a surface finish or to prepare metal for a specific technique, such as enameling, kum boo, or granulation.

PROCESS

HEAT the metal to its annealing temperature.

PICKLE the metal until it looks white (for silver) or light yellow (for gold).

SCRUB the metal with a brass brush until it's shiny.

REPEAT this process three or four times until you can no longer see any firescale and the surface color looks even.

Sawing & Piercing

Sawing and piercing are two of the most basic yet essential techniques for making metal jewelry. Not only are these skills used for cutting out basic forms, but they can also be used for making extremely complicated designs. Piercing metal means to cut out negative shapes from the interior of a metal sheet. (Sawing can simply be performed from the sheet's outer edge.) Before metal can be pierced, a hole must be drilled in the interior of the sheet. To properly saw and pierce metal takes practice, but can be learned quickly if you set your mind to it.

Installing a Blade into a Saw Frame

Once installed, the saw blade should be quite taut in the frame. If you pluck the blade like the string on a musical instrument, it should make a nice pinging sound. However, if the blade is too tight or too loose in the frame, it can break quite easily.

PROCESS

OPEN the jaw of the saw frame to a length that is approximately 10 mm longer than the length of the saw blade.

INSERT the saw blade into the top nut of the saw frame with the teeth of the blade facing out and pointing down, and tighten the nut.

REST the end of the saw frame handle on your sternum, and rest the top edge of the saw frame against a jeweler's bench or worktable, with the blade facing up.

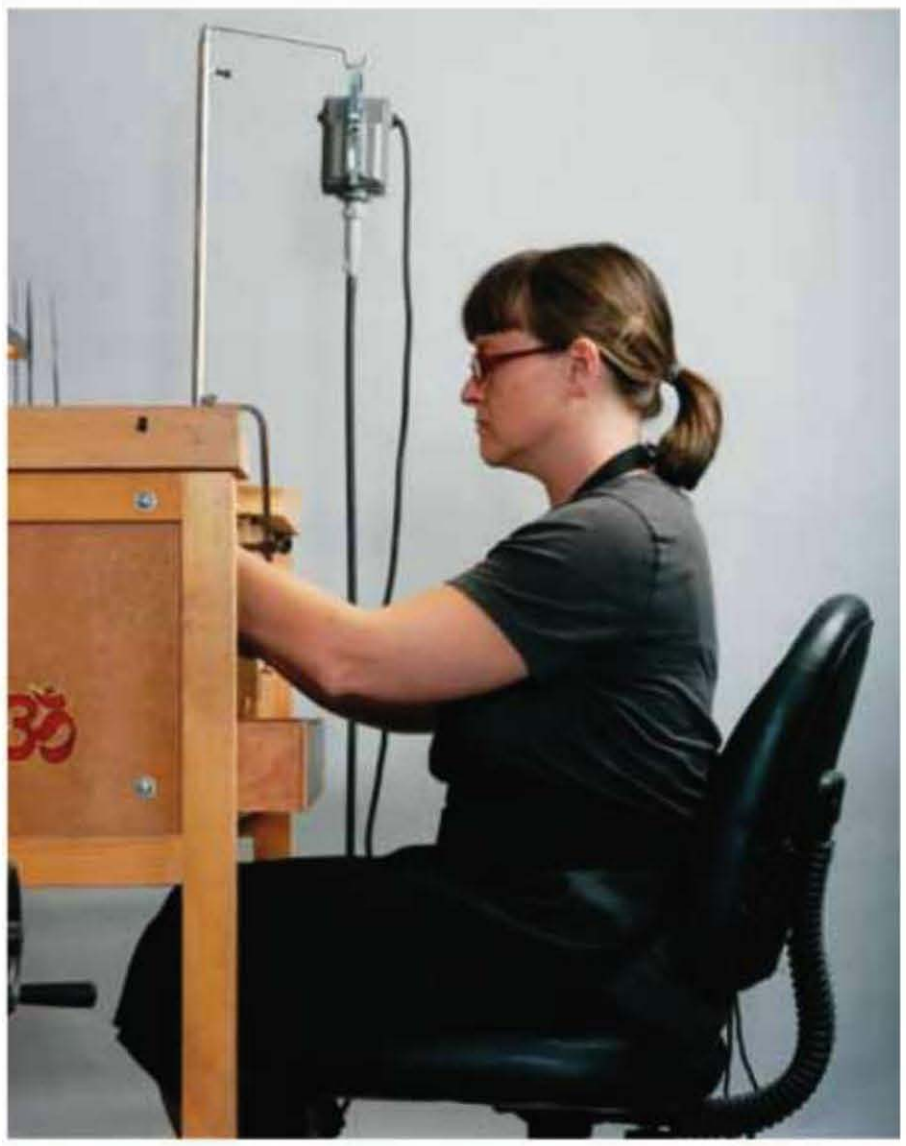
PUSH the saw in with your sternum to slightly shorten the length of the jaw.

PLACE the end of the saw blade into the lower nut while the jaw length is shortened, and tighten the lower nut (see photo).

RELEASE the pressure on the saw frame.

Sawing Posture

Sawing near eye level makes it easier to see what you are doing, but this positioning is not just for convenience. You can develop serious back problems from working in an incorrect body posture. Most jeweler's benches are about 1 foot (30.5 cm) taller than normal tables specifically for this purpose. If you are sawing at a table of normal height, sit on a short stool. In addition to being at the right height, it's very important to keep a straight back while sawing.



Sawing Metal

Practice sawing with different sizes of blades to see how they cut different types and gauges of metals.

PROCESS

PLACE the metal on the bench pin.

MAKE one quick upward stroke up the metal's edge with the saw blade to create a small indention, a good place for the saw teeth to bite.

PLACE the top of the saw blade on the indention and move the saw frame up and down, keeping the blade at a 90-degree angle to the metal being cut and the frame pointing forward at all times, unless you're turning a sharp corner.

Tips

- Hold the saw lightly in your hand. You should not be gripping the handle very hard. It should be merely resting in your hand.
- Let the saw teeth do all the work on the downward stroke. Do not apply any pressure from your hand.
- Run the blade against a block of beeswax prior to sawing. This gives you a smooth stroke and helps cut down on the rough bite of the saw blade.
- When rounding a corner or sawing an arc, turn the metal sheet, not the saw frame. To turn a sharp corner, simultaneously and quickly turn the metal and the saw, while moving the saw up and down to complete the turn.
- Beginning metal workers usually break a lot of saw blades. No need to fret if this happens to you—you'll become quite proficient with a little practice.

Drilling Metal

Always drill metal on top of a wood block designated just for this purpose. The wood block protects your bench pin or work surface and it also provides support while drilling.

PROCESS

DETERMINE where to drill the hole in the sheet metal.

PLACE the sheet metal on a steel block.

USE a center punch and chasing hammer to lightly indent, or dimple, the surface of the metal.

The dimple guides the drill bit to a specific spot. Without an indention, the bit can swerve over the metal surface, making marks that would have to be sanded off later. Dimpling before drilling also ensures that the hole is made in a precise location.

To dimple a hollow form or curved structure, use the pressure of your hand rather than a hammer blow to make the indention with the center punch.

INSERT the drill bit into the flexible shaft securely.

PLACE the dimpled metal sheet on a wood block.

DRILL the hole with an even, medium speed.

Sawing an Interior Shape

This process is also known as piercing.

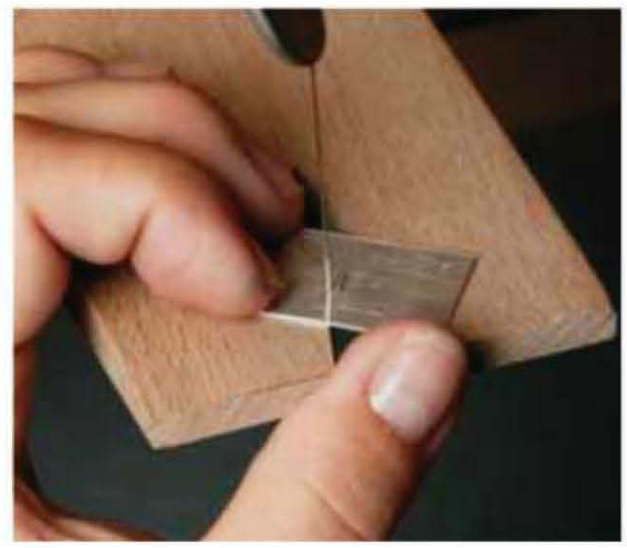
PROCESS

THREAD the saw blade through a hole drilled in a metal sheet.

ATTACH the blade to the bottom nut on the saw frame, and tighten the nut.

It's helpful to rest the saw frame against your sternum and the workbench while holding the metal in one hand and tightening the nut with your other hand.

SAW the interior shape out of the metal.



Tips

- Do not drill with the flex shaft motor racing or with it creeping along. Use an even, medium speed. Exert a small, firm amount of pressure to help push the drill bit through the metal.
- When drilling thicker metals, dip the bit into beeswax or some lubricating oil before drilling each hole. This extends the life of your drill bit.
- Always keep the drill bit at a 90° angle to the metal, or the bit may break.
- If a drill bit breaks and gets stuck in the metal, soak it overnight in a solution of alum and water. This helps dissolve the bit, making it easier to remove.

Filing

After all sawing and piercing is complete, you'll likely need to file the cut metal edges. Filing can also remedy uneven lines by removing metal in specific areas. Files come in many shapes and sizes, all with varying coarseness of teeth.

Filing

The teeth on a file are all pointed in one direction. This causes the tool to remove metal only on a forward stroke. The file won't remove metal on a backward stroke, but it will scratch the metal. (The scratches may give a false impression that metal has been removed.)

PROCESS

SELECT a file with a shape and coarseness that is appropriate for the metal.

REST the metal to be filed on the bench pin in order to get the most out of each file stroke.

No "air filing"—holding the piece in midair while working—is allowed!

MOVE the file in a firm, even stroke on the metal in the area to be reduced.

Carving

Carving removes large amounts of metal to form the shapes you desire. A variety of tools can be used for carving metal, including jeweler's saws, files, and several flexible shaft attachments such as burrs. The tools you use for carving depend on the design you want to achieve. To remove large amounts of metal, you may need to start with rough burrs and files, then switch to fine files for more detailed work, then perhaps sandpaper or smaller, more precise burrs. A ring clamp or pin vise maybe useful for holding work while you carve.

New Tools

A ring clamp is a useful tool for firmly holding an object in place while you're working on it. Insert the shim to lock the jewelry piece in the jaws. Rest the ring clamp against the bench pin for ease in working.

A pin vise is used for holding small items such as pin stems or other small bits of metal while you're working. A pin vise has four slots of varying sizes that can hold small objects; each removable head has two different sized holding slots.

Straightening Wire

Wire is straightened by pulling. For thinner gauges, place one end of the wire in a vise and the other end in a pair of pliers or draw tongs. Gently pull until you feel the wire actually stretch.

Thicker gauge wire can be easily straightened on a drawing table with the winch doing the most of the work. For this option, place one end of the wire in a pair of draw tongs at a drawing table. Secure the opposite end in another pair of draw tongs, and then slowly turn the crank.

New Tool

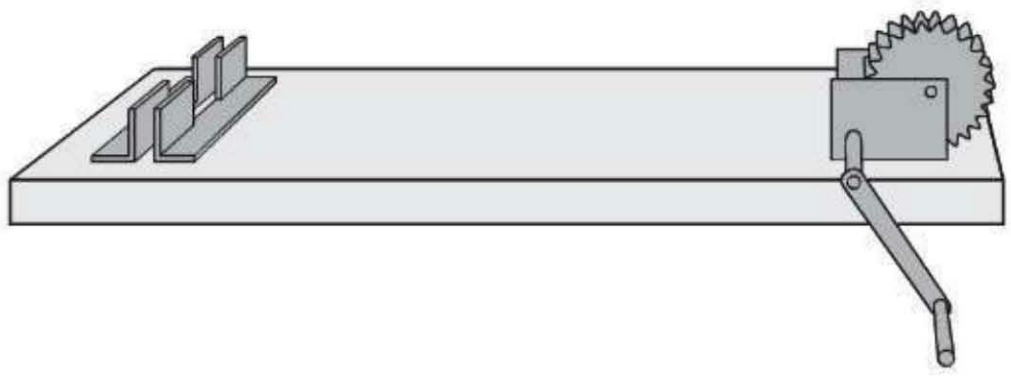
Draw tongs look like a large pair of pliers. The jaws of these tongs are crosshatched on their interior surface so they can grip wire as it is being pulled through the drawplate. One or more of the ends of draw tongs are curved to attach to the ring that's connected to the winch on a draw table.

New Tool

A drawplate is a necessary tool for drawing wire. It has many holes in descending sizes that are shaped like small funnels.

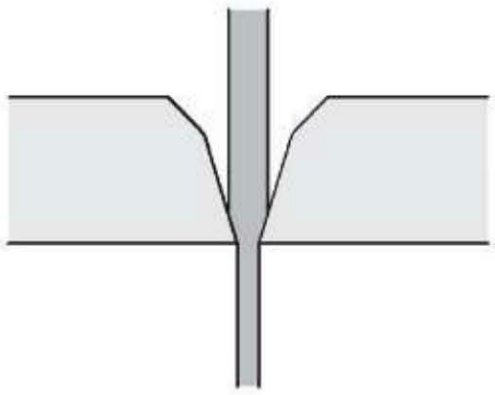
New Tool

A drawing table decreases the amount of manual work needed to pull wire through a drawplate. You can purchase this setup or make your own with a long table, a stop of some sort, and a boat winch. This option works well and is very inexpensive. This setup can also be used to pull wire straight.



Drawing Wire

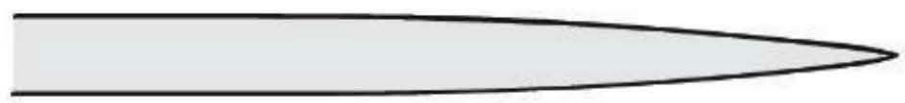
Drawing wire is a process used to make wire smaller in gauge or to change its shape while simultaneously reducing its gauge. Wire is fed through the larger "funnel" opening and pulled from the other, smaller side with draw tongs. Because the wire is forced through the small hole, it ends up being smaller.



Side view of drawplate in use

Before wire can be drawn, one end must be forged or filed smaller than its original diameter. This wire end must fit through both sides of the hole in the drawplate and extend past the smaller hole far enough to be grasped with draw tongs. When drawing thin wire, it's best to file the end. When drawing thick wire, forging the end will save time.

Step-forged wire end



Filed wire end

Drawing Wire

If you're drawing wire down to a much smaller diameter, it's helpful to anneal the metal between every other hole. Make certain to thoroughly dry the wire before drawing to keep the drawplate from rusting.

PROCESS

COVER the jaws of a vise with scrap copper or leather pieces to protect the drawplate.

POSITION the drawplate in covered jaws of the vise horizontally, with the smaller side of the hole facing the proper direction.

Setting the drawplate in the jaws of the vise horizontally prevents the plate from breaking. The steel may seem very strong, but over time it certainly can break.

FEED the thinner end of the wire through the hole in the drawplate.

GRAB the wire with the draw tongs and pull it all the way through the hole in the drawplate.

REPEAT this process if desired in the next smaller hole to continue reducing the gauge of the wire. (Do not skip any holes in the sequence.)

Melting

Controlled melting can be useful in jewelry making, not only as a design option but also for technical purposes.

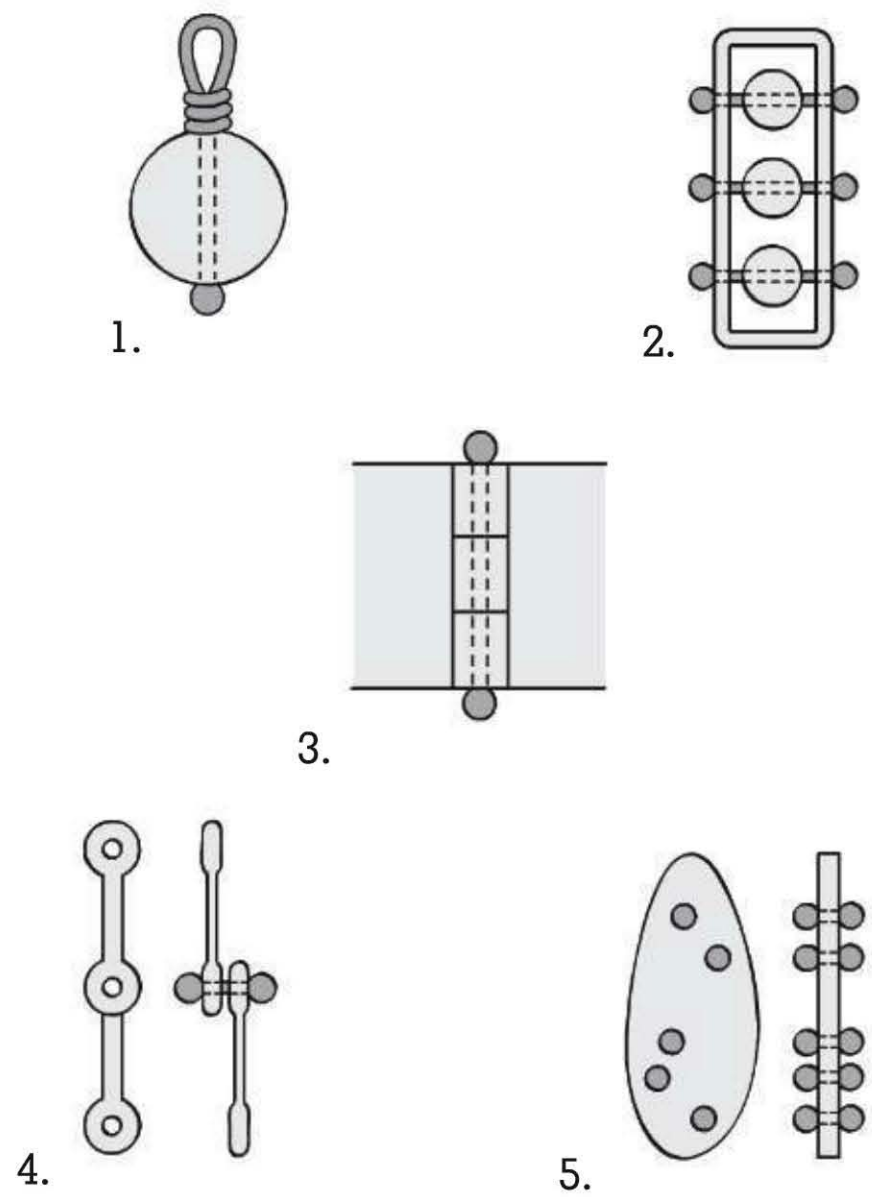
Controlled melting requires a hotter torch, such as a mini torch. Acetylene with ambient air is not hot enough in most cases.

Edge Melting

Melting metal edges makes an interesting texture that is similar to reticulation. Simply turn up your torch to create a finer, hotter flame and melt the edges of the sheet. Take care not to overuse this technique and to employ it in an original, attractive fashion.

Wire Melting

By melting the ends of wire, you can make headpins or add interest to hinge pins. Turn up the torch to create a small, hot flame and melt the end of the wire into a ball. Use fine silver wire to make perfectly round balls. Most karats of gold make attractive balls, but copper balls almost always have pits. Try putting a small amount of flux on the wire to avoid this. Sometimes it works, but not always.



Examples of ways to use balled wire

1. As headpin
2. To secure beads
3. To secure hinge
4. To join links
5. For decoration

Melting Scrap to Make Sheet

Making sheet from scrap metal helps to save money, especially when working with gold. It's also useful when you need thicker sheet but don't want to buy in quantity. Silver and gold are the best metals with which to make your own sheet.

PROCESS

Important Safety Note
When melting metal to make sheet, the material will get red hot. Always wear dark safety glasses (shade 5) to protect your retinas from being burned, which can lead to vision loss.

CARVE a small depression in a compressed charcoal block with an old knife or cutting tool.

The depression will keep the metal from rolling off the block when it's molten.

This process is very messy, so you might want to do it outside.

GATHER clean metal scraps (scraps with no solder) and pile them on the compressed charcoal block.

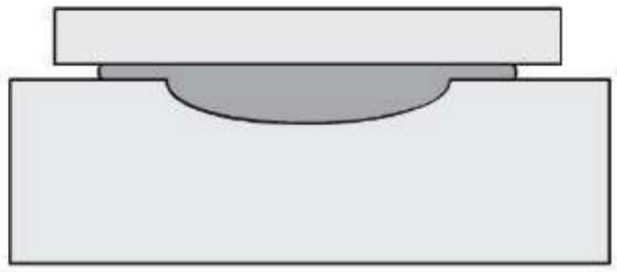
LIGHT the torch and turn it up to a very hot flame.

The flame should be high, but not high enough to blow the metal scraps off the charcoal block.

HEAT the metal scraps until they melt and form a blob.

STIR the blob gently with a titanium solder pick to make sure all metal scraps are melted.

REMOVE the heat and slowly but intentionally place a steel block on top of the molten metal to flatten and cool it.



Do not place the steel block on the molten metal too quickly or firmly. It could push out the molten metal and possibly burn you.

REMOVE the metal from the block and quench it in water.

FINISH the metal sheet by forging it flat or rolling it in a rolling mill to obtain the desired gauge.

The sheet will probably need to be annealed after every two passes through the rolling mill.

If the sheet begins to crack, anneal it. If the annealing doesn't stop the cracking, you may need to re-melt that area to keep the crack from splitting through the sheet.

Tip

Use a similar process to make your own wire. Carve a small trough in a compressed charcoal block, melt the metal into it, and then hammer the metal or roll it in the mill until it's uniform enough to be pulled through a draw plate.

Making Connections

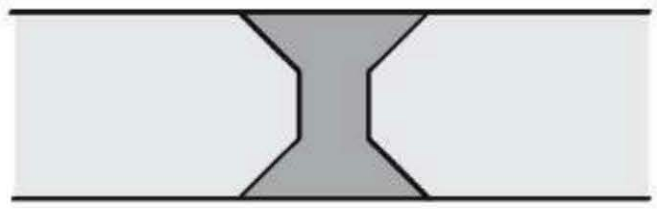
This chapter is about joining materials, a fundamental process in making jewelry. There are many ways to connect metal, and the more methods you know, the more creative options you'll have for realizing your design. Connections can be rigid and permanent, such as a soldered seam, or flexible, such as linked rings.

Cold Connections

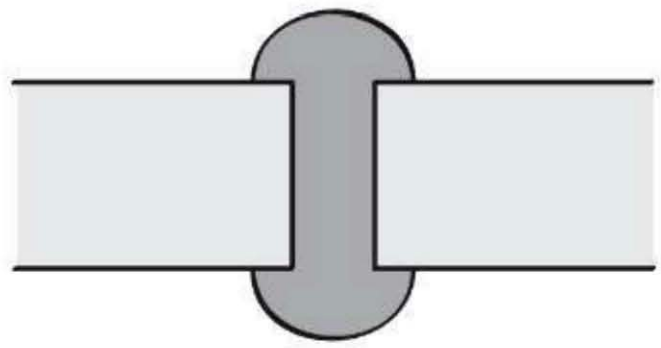
Cold connecting is the act of joining metal elements together without using heat. This method permits the connection of ferrous and nonferrous metals and the inclusion of elements that cannot take heat, such as found objects and enamels.

Riveting

The primary type of cold connection used in jewelry is the rivet. A functional rivet secures two or more pieces of metal together or joins some other element to metal. The rivet passes through the layers of material and is flared on each side. The three types of rivets—tube, wire, and split—function the same, but look different. Rivets can also be wonderful decorative accents without performing an actual function.



Flush or hidden rivet



Rivet with rounded heads

Rivet sampler

Wire Riveting

A successful rivet head initially will look like a small mushroom. Sand and polish the "mushroom" to clean it up, or carve or chase the rivet head for a different look.

PROCESS

MEASURE the thickness of the metal to be riveted with calipers.

DETERMINE where you want to place the rivet, and dimple the metal at this point.

DRILL a hole through the metal using a bit that is the same diameter as the rivet wire.

CUT a length of rivet wire with the jeweler's saw that is approximately 2 mm longer than the thickness of the metal sheet.

SAND the ends of the cut wire with 400-grit paper to remove burrs.

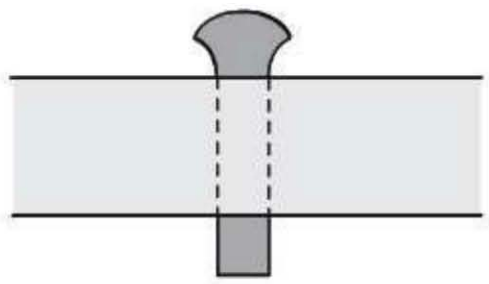
THREAD the rivet wire though the hole drilled in the sheet metal.

PLACE the threaded metal on the steel bench block.

TAP one end of the rivet wire gently, two or three times, with the chasing hammer.

TURN the threaded metal over on the steel block.

ADJUST the length of the rivet wire so an equal amount extends beyond each side of the drilled hole.



TAP the rivet wire gently, two or three times, with the chasing hammer.

TURN, ADJUST & TAP the wire until its ends "mushroom," forming the completed rivet.

Tips

- Always make rivets with wire that is 20 gauge or thicker. Thinner wire simply isn't strong enough.
- Always use the jeweler's saw to cut the rivet wire. Never cut it with snips, as they leave an uneven end on the cut wire.
- If the wire bends before the rivet is complete, you may have cut the rivet wire too long. The other possibility is that you didn't turn over the metal enough times to rivet the wire in equal amounts. It is essential to keep turning the piece over and mushrooming the ends in equal amounts.
- Use a cup burr attachment on the flexible shaft to make a completed rivet head rounder and more uniform. Cup burrs have teeth on the inside of the cup.

New Tool

A flaring tool is used to flare the open end of a tube rivet. Any small hand tool that is tapered at one end and flat at the other will work. Old burrs and chasing tools are excellent candidates to be altered into flaring tools.

Tube Riveting

To make an attractive tube rivet, be patient and flare the tube slowly, using gentle taps on alternate sides of the tube.

PROCESS

MEASURE the thickness of the metal to be riveted with the digital calipers.

DETERMINE where you want to place the rivet, and dimple the metal at this point.

DRILL a hole through the metal using a bit that is the same diameter as the tubing.

CUT a length of tubing with the jeweler's saw that is approximately 3 mm longer than the thickness of the sheet metal.

SAND the cut ends of the tubing with 400-grit sandpaper.

THREAD the tubing through the hole drilled in the sheet metal.

PLACE the threaded sheet metal on the steel bench block.

INSERT the flaring tool into one end of the tubing.

TAP the flaring tool once with the chasing hammer.

TURN over the threaded sheet metal.

ADJUST the length of the tubing so an equal amount extends beyond each side of the hole.

INSERT the flaring tool into the end of the tubing.

TAP the flaring tool once with the chasing hammer.

REPEAT this process of tapping, turning, and adjusting until the tubing can't be removed from the drilled hole.

MAKE gentle taps directly on the tubing with the ball side of the chasing hammer to continue flaring the tubing.

TURN over the sheet metal to tap an equal amount on both ends of the tube until the rivet is secure.

Pre-Flaring Tube Rivets

When tube riveting in hard-to-reach places, pre-flaring one side of the tube is a simple process that makes your work much easier.

PROCESS

CUT a length of tubing with the jeweler's saw that is approximately 3 mm longer than the thickness of the sheet metal.

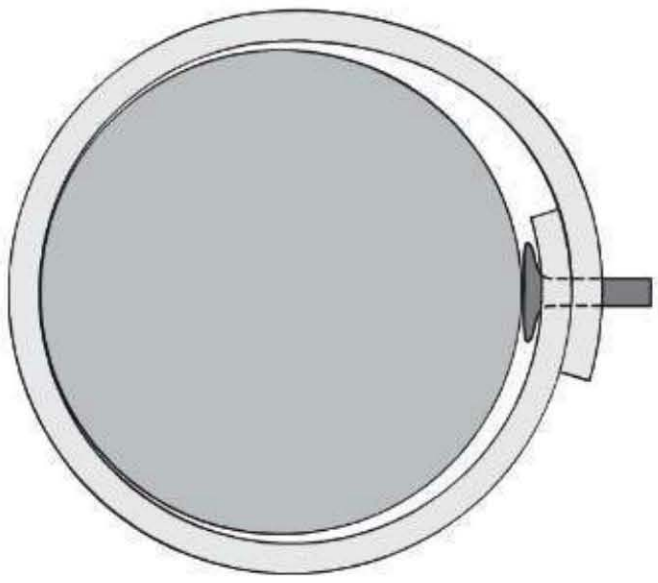
SAND the cut ends of the tubing with 400-grit sandpaper.

PLACE the tube on the steel bench block and insert the flaring tool into one end of the tube.

TAP the end of the flaring tool gently with a chasing hammer to create a nice flare in the tube. (Do not to tap too hard or you'll compress the tube end that is resting on the steel block.)

FEED the tube into the rivet hole with the pre-flared end in the location that is difficult to reach.

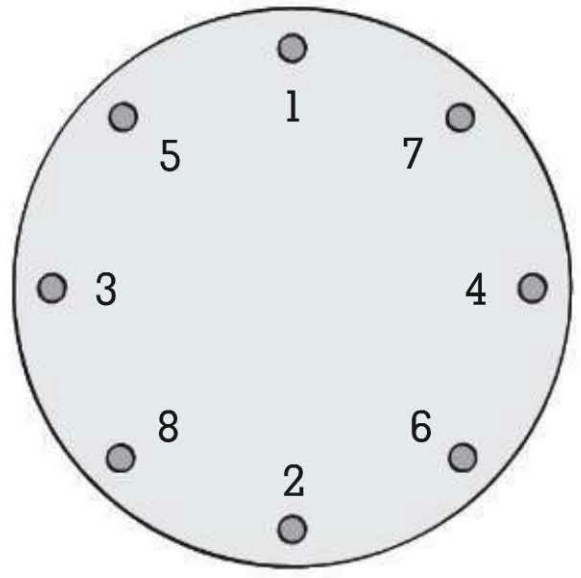
HOLD a resistant surface, such as a ring mandrel, against the pre-flared end of the rivet as shown below.



TAP the exposed tube end with the chasing hammer and the force of the blows will secure both sides of the rivet.

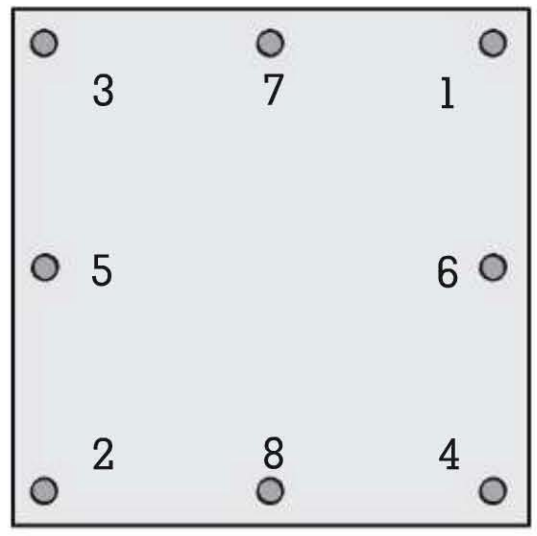
Making Multiple Rivets On a Circle

Riveting diagonally across the circumference of a circle helps to secure the metal pieces in the proper position. When making multiple rivets on a circle, use the "clock method." Make the first rivet at 12 o'clock, the second at 6 o'clock, the third at 9 o'clock, the fourth at 3 o'clock, and so on. Drill a hole and complete the rivet at each location. Do not drill all the holes first, as this will almost always cause your holes to be misaligned.



Making Multiple Rivets On a Square or Rectangle

Rivet one corner, and then the corner that is diagonally opposite. Make the third rivet horizontal to the first rivet, and then finish with the remaining corner and any additional locations.



Tip

If you wish to add rivets for decorative purposes, it's best to drill these holes after the functional rivets are holding the metal in place. This way, you can be certain the holes line up in both metal sheets.

Making Split Rivets

Split rivets can be made from wire or tube. The ends of the rivet are cut with slots, the rivet is threaded through the metal to be joined, and then the slotted ends are manually flared. When making a wire split rivet, use wire that is thicker than 14 gauge or it will be difficult to slot the ends. Similarly, it's best to use tubing with an outside diameter (OD) that is larger than 3 mm.

PROCESS

MEASURE the thickness of the sheet metal to be riveted, using calipers or a ruler.

CUT a length of tubing or wire with the jeweler's saw that is at least 3 mm longer than the thickness of the metal.

SECURE the wire or tube so you can make a clean cut with the saw.

You can use parallel pliers, your fingers (if the metal is long enough), a ring clamp, or a 45/90° miter jig to tightly hold the wire or tube. Determine which of these methods works best for you.

CUT slots in both ends of the wire or tubing using the jeweler's saw or separating disc, leaving as much unslotted space as the thickness of the objects to be riveted.

Although you can cut as many slots as you like, beginners should start with four. It can be tricky to cut straight lines, so work with care. If you cut the slots with a separating disc, make sure to wear safety glasses.

DETERMINE the location for the rivet, and dimple the sheet metal at this point.

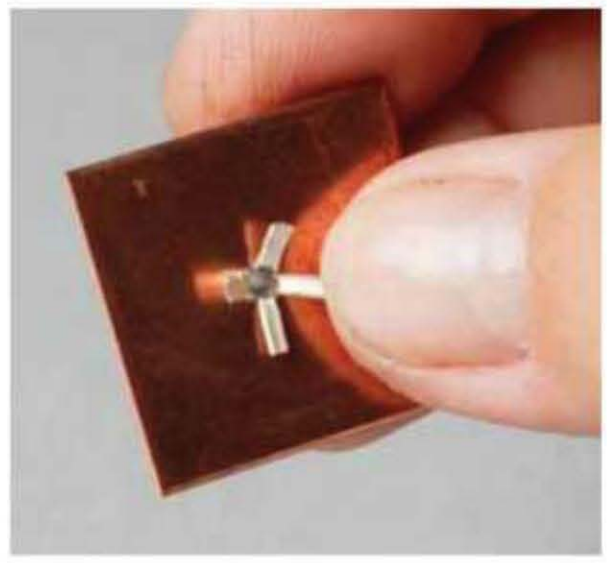
DRILL a hole that is the same diameter as the tubing or wire.

INSERT the slotted rivet into the drilled hole.

FLARE one slotted end of the wire or tube with your fingers.

If you cannot bend back the metal with your hands, use flat- or chain-nose pliers.

BEND all the slots on both ends of the rivet against the sheet metal.



HAMMER the flared rivet with the ball side of the chasing hammer to firmly secure.

Some objects being riveted will not withstand the force of a hammer blow. Use your judgment and omit this step if needed.

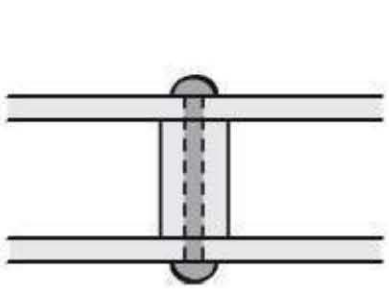
SAND the split rivet with 400-grit paper to remove all burrs.

Tips

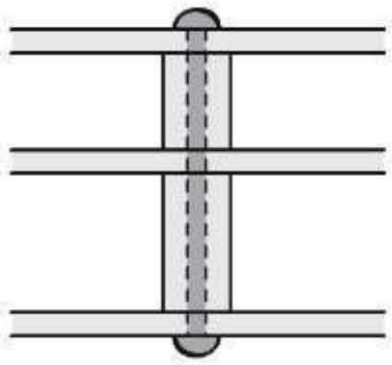
- Keep in mind that you can make the ends of a split rivet longer for decorative purposes. Experiment with different lengths to discover the possibilities.
- If they are long enough to make a secure rivet, the ends of a split rivet don't have to be slotted to the same length.

Riveting with Spacers

Through the use of spacers, two or more sheets of metal or other objects can be riveted together with a gap left between them. Examples of spacers include pieces of telescoping tubing, a jump ring that fits securely around a rivet, or a decorative piece of sheet metal. Spacers can move freely or they can be quite tight between riveted objects. Using spacers can add dimension, movement, and creativity.



Rivet with spacer



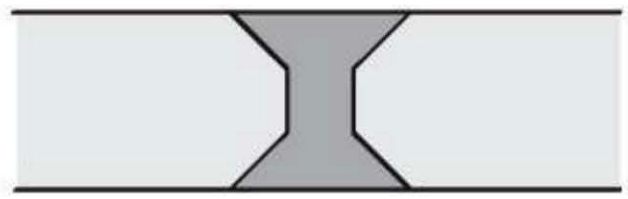
Rivet with multiple spacers

A spacer must fit precisely onto the wire or tube rivet. If the inside diameter (ID) of the spacer is too large for the outside diameter (OD) of the wire or tube rivet, the spacer will not have sufficient support for the required hammering, and the rivet can bend.

To make a moving spacer, place a thin sheet of cardboard on top of the spacer before adding the final layer of the material to be riveted. The cardboard provides support during the riveting process, and once detached, enables the spacer to move. Once the rivet is complete, remove the cardboard by tearing it out or by soaking the piece in water.

Making Hidden Rivets

A hidden rivet secures metal the same way as any other rivet. The difference is in appearance. The rivet metal sinks into a depression, and the top is filed off to create the illusion that the rivet is not actually there.



PROCESS

CREATE rivet holes as if making a standard rivet.

In order for a hidden rivet to have sufficient strength for a secure attachment, the material must be at least 1 mm thick.

USE a round burr or a conical burr of any kind to remove metal on one or both sides of the rivet hole.

RIVET the metal.

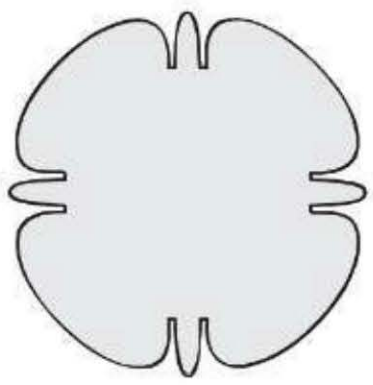
USE a file or a flex shaft attachment to remove the excess rivet material until the head is flush with the surface of the metal.

Tips

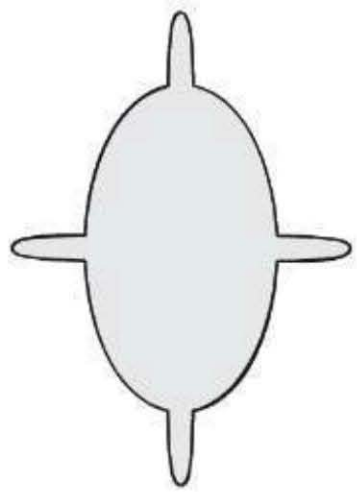
- Using a different color of metal for the rivet wire in a hidden rivet creates an interesting look.
- Solder a metal shape on one side of a rivet and rivet the other side as normal. This type of rivet can be great when you want a decorative side and a purely functional side.

Tabs

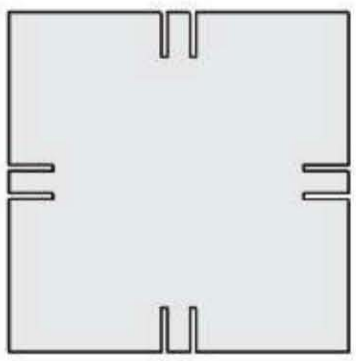
Tabs are segments of sheet metal used as a type of prong to hold objects in place or to hold pieces of metal together. Tabs can be sawed or soldered, and decorative or purely functional. Sometimes the pure functionality of tabs makes them decorative in their own right. Be creative with your tab usage.



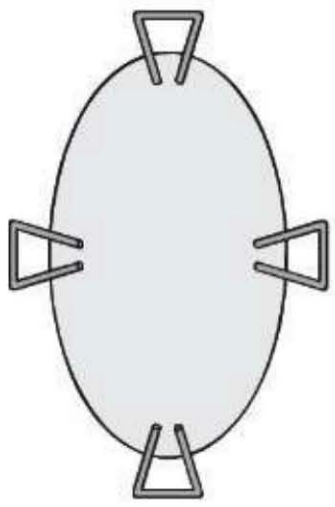
Sawed tabs



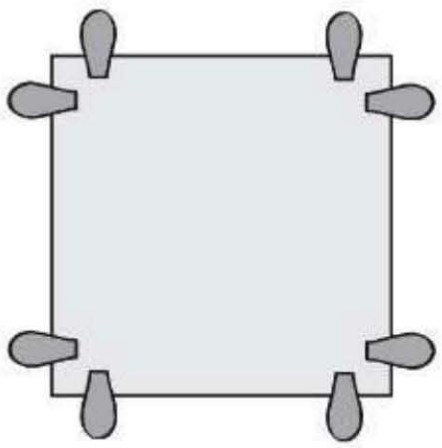
Sawed tabs



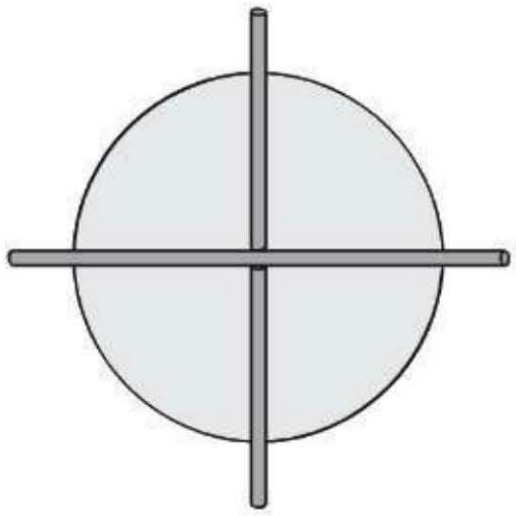
Sawed tabs



Soldered tabs



Soldered tabs



Soldered tabs

Making Tabs

When designing a piece of jewelry, make certain the tabs are long enough to trap the desired object in place. Also, make sure the width of the tab is large enough to be secure as well.

PROCESS

SAW out the tabs on the edge of the sheet metal or solder them in place.

FINISH the metal as desired.

BEND the tabs into place with flat-nose or chain-nose pliers.

If the tabs seem springy and don't sit next to the object correctly, gently wiggle the tabs side to side while pushing them toward the object.

Nuts & Bolts

Commercial nuts and bolts are a great way to join metal elements. Several companies sell miniature nuts and bolts in brass and nickel for use in jewelry making and other crafts. Simply drill a hole of the proper diameter, thread a nut in the hole, and secure it with a bolt. (If the nut is too long, you can cut it with a jeweler's saw.) Similarly, tiny screws are available, as well as tiny screwdrivers.

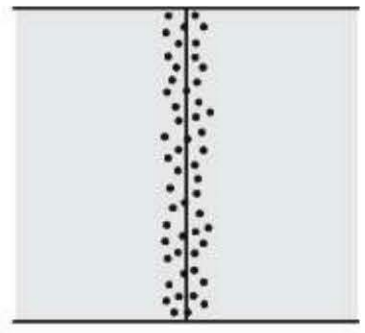
Adhesives

Adhesives are for attaching materials of differing substance, such as plastic to metal or wood to metal. They should never be used in place of soldering. Adhesives should not be used to hold stones in place; the only time this is appropriate is when a pearl is glued onto a pearl peg. There are a multitude of adhesives on the market. Your best bet is to read the labels on different adhesives—for both recommended uses and safety considerations—and then experiment to find the glue that works best for your specific needs.

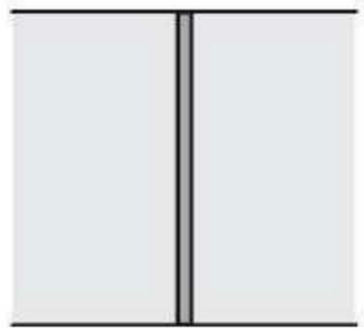
Two types of adhesives are useful for jewelry making. One is a two-part epoxy that dries hard and clear with a yellow tint. It is useful for gluing a pearl on a peg, metal to wood, or metal to plastic. The second type, manufactured for attaching watch faces, remains flexible once dry. Use flexible epoxy when stringing pearls or other semiprecious beads. The flexibility of the adhesive is important so it won't break silk thread or other fibers once dry. The brittleness of a two-part epoxy will cause problems with thread breakage and, eventually, unsecure jewelry.

Hot Joining

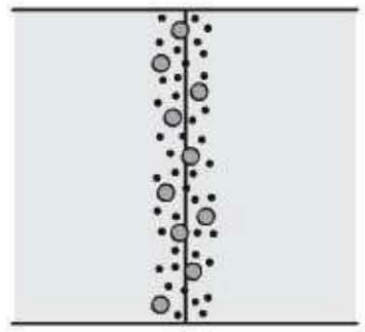
Nonferrous metals are joined with heat in two ways: soldering and fusing. High-temperature soldering is often called brazing. Ferrous metals are joined with heat through the process of welding, which differs from soldering.



Fusing
Sheets join on a molecular level without a bonding agent



Soldering
Sheets join with a bonding agent



Welding
Sheets join with a bonding agent and on a molecular level

Fusing

Fusing joins like metals with heat. The surface area of each part to be joined touches, melts, and then adheres together. The molecules in the melted areas literally mix and join, forming a bond without any additional bonding agent, such as solder.

The tricky part of fusing is that the process has a very quick and limited working time. If the metal is overheated, it will simply melt. If the metal is

underheated, it can oxidize and form a layer of oxidation that prevents the fusion of the materials. To avoid the problem of oxidation, fusing is most often used with pure metals, such as fine silver or fine gold. Argentium silver is an excellent alloy to fuse because it doesn't oxidize easily. It's possible to fuse with sterling silver or lower karat gold (such as 18- or 14-karat) if the fine silver and the fine gold are first brought to the surface by means of depletion gilding.

To fuse metal, the parts to be joined must be flush, must be clean, and must be heated to the correct temperature. If your metal does not fuse, first verify that the metal parts meet these three conditions.

Soldering

Soldering joins metals together with heat and solder. Similar to hot glue, solder is a bonding agent that requires heat for proper joining. Most nonferrous metals are joined with silver solder. Although the color of silver solder doesn't match bronze, copper, or brass, it is the appropriate medium for joining these metals. Gold solders are available for soldering gold and other nonferrous metals.

There are many methods for soldering metal. Some are based on the use of different techniques and some are based on using different forms of the solder itself. At times, you may find it necessary to alter your soldering technique to accomplish certain processes. At other times, you may need to alter the form of the solder to achieve the desired results. Advance planning will help the process go smoothly.

Before you solder, determine these three things:

- The best type of soldering operation
- The best form of solder
- The best setup for the pieces to be joined

Soldering Materials

Soldering Blocks

A soldering block is a heat-resistant work surface that can withstand high temperatures without completely melting. Blocks are made from different materials, including ceramic, charcoal (below, top), compressed charcoal, silica (below, bottom), and pumice. Charcoal blocks are best at reflecting heat, while compressed charcoal blocks have the most longevity. Although noncombustible, ceramic, silica, and pumice blocks will melt after repeated use and must be periodically replaced. Choosing which type of soldering block to use is up to the individual jeweler. Experiment with different kinds to discover which one you prefer. You may find that you like different types of blocks for different soldering applications. Make absolutely certain, without exception, that your soldering blocks are asbestos free.

Flux

When metal is exposed to oxygen, the deposit that forms on its surface is called an oxide. This process is called oxidation. Applying heat to metal greatly accelerates the oxidation process. Flux is a substance that must be applied to the surface of metals before they are soldered. Flux prevents oxides, in the air and in the heat, from dirtying the metal, allowing the solder to properly flow and the metals to permanently join.

Flux is manufactured in several forms for use in different soldering applications. The most common form for jewelry making is a white paste flux that is applied with a small paintbrush. Liquid flux is also available. Apply it with a spray bottle or a needle tip dispenser.

Tip

If you need to add more flux while soldering, use dry flux in a saltshaker and sprinkle it on the work from above. This method avoids the flux brush touching the hot metal, where it could stick and burn. Making dry flux is simple: air dry some paste flux, grind it with a mortar and pestle to a superfine consistency, and load it into a salt shaker.

Flux will not decompose at high temperatures. After prolonged heating, however, most types of flux will burn off metal. Some manufacturers sell high-temperature fluxes that lessen the problem of burn off, but a standard water-soluble flux will work well for most jewelry applications.

Safety

Flux is usually made of boric acid, potassium fluoride, and potassium tetraborate. (The chemical composition varies by brand and by type.) Be aware that flux gives off poisonous gases when heated, and that these fumes can cause respiratory and skin damage. For these reasons, it's critical to have good ventilation when soldering. Short-term exposure to these fluorides is usually harmless, but long-term exposure can have serious side effects. When working with any chemical such as flux, it is imperative to read the material safety data sheet. Non-flouride fluxes are also available and should be used whenever possible.

Solders

Solders are manufactured with different melting temperatures and are categorized by this quality. Although there are five primary classifications of solder—IT, hard, medium, easy, and extra easy—most jewelers use only hard, medium, and easy. (IT solder is used for soldering pieces that will later be enameled, and easy flow solder is often used in repair work.) No matter what metals you're joining, it's best to begin with a high-temperature solder and perform subsequent operations with lower temperature solders. Make sure to mark your solders by type. It's easy to mistake wire solder for sterling silver wire.

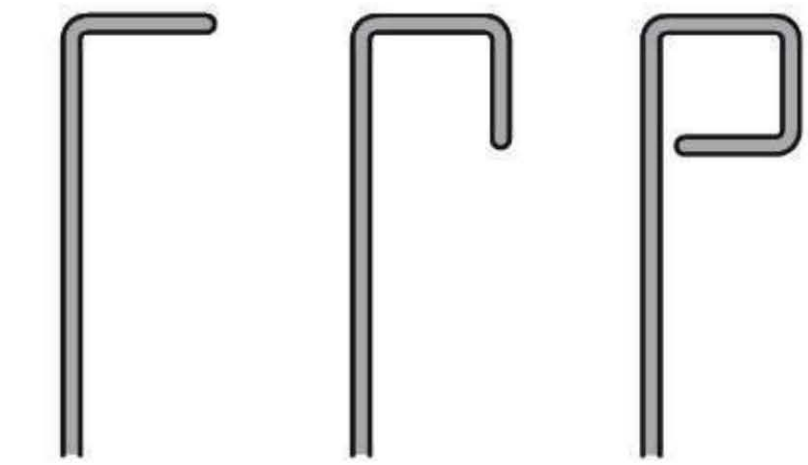
Solder should be clean—free of dirt and grime, such as sticky tape residue or glue—before using. However, there's no need to pickle or sand it. Lightly tarnished solder is perfectly fine to use.

Solder Forms

Solder is sold in several forms. Gold solder is only available in sheet form, while silver solder is available in sheet, wire, precut snippets, paste, and powder. Some forms of solder are better to use in certain applications, and you may choose one form over another based on your personal preference.

Tip

Precut snippets can be purchased from jewelry suppliers. These are convenient when you need to use the exact same size of solder for several operations.



Bend the end of wire solder to indicate its melting temperature.

Solder Snippets

Solder snippets can be cut from either sheet or wire solder. Both wire and sheet snippets perform in the same manner, so selecting the form to use is a matter of personal preference. Position cut solder snippets on a small, compressed charcoal block. This allows the surface holding the solder to be heated without catching fire or causing injury. Use scissors to cut snippets from sheet solder. Use metal snips to cut snippets from wire solder.

Cutting Wire Solder Snippets

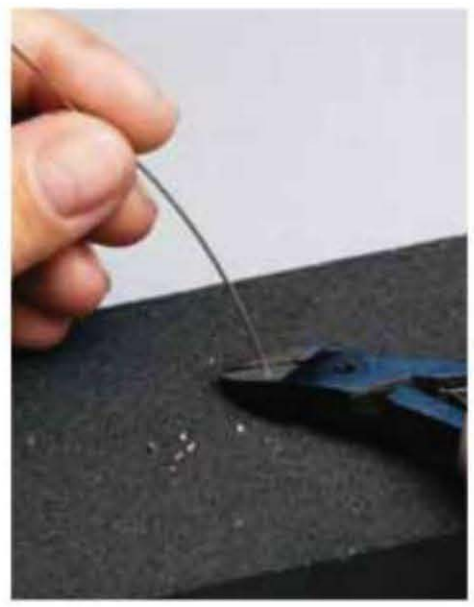
This method deposits the snippets in a single spot on a charcoal block. Otherwise, they are likely to fly wildly around your workspace.

PROCESS

TURN the snips upside down over the charcoal block with the closed part of the jaw facing up.

INSERT the solder wire into the snips from above.

CUT the wire solder into small pieces.



Paste Solder

This is fine powdered solder that has been mixed with a viscous flux. Paste solder is sold in a syringe so you can squeeze out small amounts. Because the powder is so fine, it covers any area on which the paste is spread. Some jewelers love this form of solder and find it useful for many soldering operations such as attaching ear posts and joining the long seams of a hollow form.

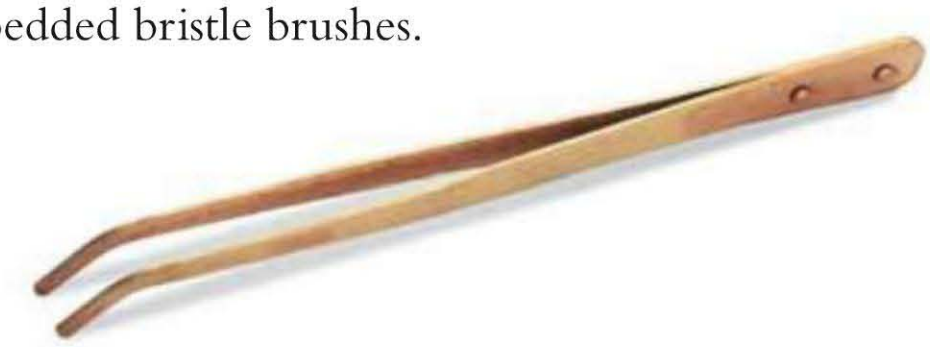
Powder Solder

Powder solder is a fine, dry powder with no flux. This form is used for specific techniques that call for a dusting of solder sprinkled from above, such as filigree, where tiny wires barely come in contact the base sheet. Powder solder is often used in combination with powder flux.

Pickle

Pickle is a solution of weak acid and water that cleans oxidation and flux off of soldered metal. Pickle works best when heated, so most jewelers warm it in a small slow cooker. Sulfuric acid once was the most common acid used in pickle, but because of the many dangers associated with its use, sodium bisulfate is now preferred. Nontoxic pickles made from citric acid are available. These are a good choice when considering health and environmental issues.

Always use copper tongs to remove items from pickle solution. Never use steel tools in the pickle. After cleaning several pieces of sterling silver in pickle, copper ions from the sterling silver latch onto water molecules. If steel is introduced into this solution, it acts as a catalyst for the release of the copper ions. The ions will then seek another piece of metal to attach themselves to, namely your silver jewelry, and the piece will end up copper plated. If this does happen to you, you must sand off the copper plating. There are a variety of flex shaft attachments good for this, such as grit-embedded bristle brushes.



Cleaning Metal in Pickle

Important Safety Information: When mixing the pickle granules into water, always add the acid to the water. Never add water to dry acid. Closely follow the manufacturer's instructions to properly mix the solution.

PROCESS

AIR COOL the soldered metal.

PLACE the metal in the pickle solution until it's clean.

REMOVE the clean metal from the pickle solution with copper tongs.

RINSE the clean metal under cold water or dip it in a solution of water and baking soda to neutralize any remaining acid.

Disposing of Spent Pickle

Pickle solution is spent when it doesn't clean metal as quickly as it initially did and looks quite green in color.

PROCESS

CARRY the pickle pot to a work sink.

ADD a few teaspoons of baking soda to the solution to neutralize the acid.

RUN water over the bubbling mixture.

WASH the neutralized acid down the work sink.

Soldering Tools

Torches

Since the torch is one of the most important tools used in soldering, you should understand your options.

Acetylene B Tank with Ambient Oxygen

This torch is relatively inexpensive and is a good tool for beginning metalsmiths. "Acetylene B" indicates the size of the tank and what type of gas it holds. A hose runs from the tank to a handpiece that has interchangeable tips of various sizes. Near the connection to the handpiece, the tips have holes that allow oxygen from the air to be pulled into the tip. The oxygen mixes with the acetylene to create hotter and cleaner flames than pure acetylene would produce. The interchangeable tips on this torch allow for the soldering of larger objects. The larger the holes on the tip, the more gas is released and the more heat the flame will emit. To determine the best fit for specific soldering jobs, practice heating different types of objects with different sizes of flames. After some time you'll easily be able to determine what size flame you need.

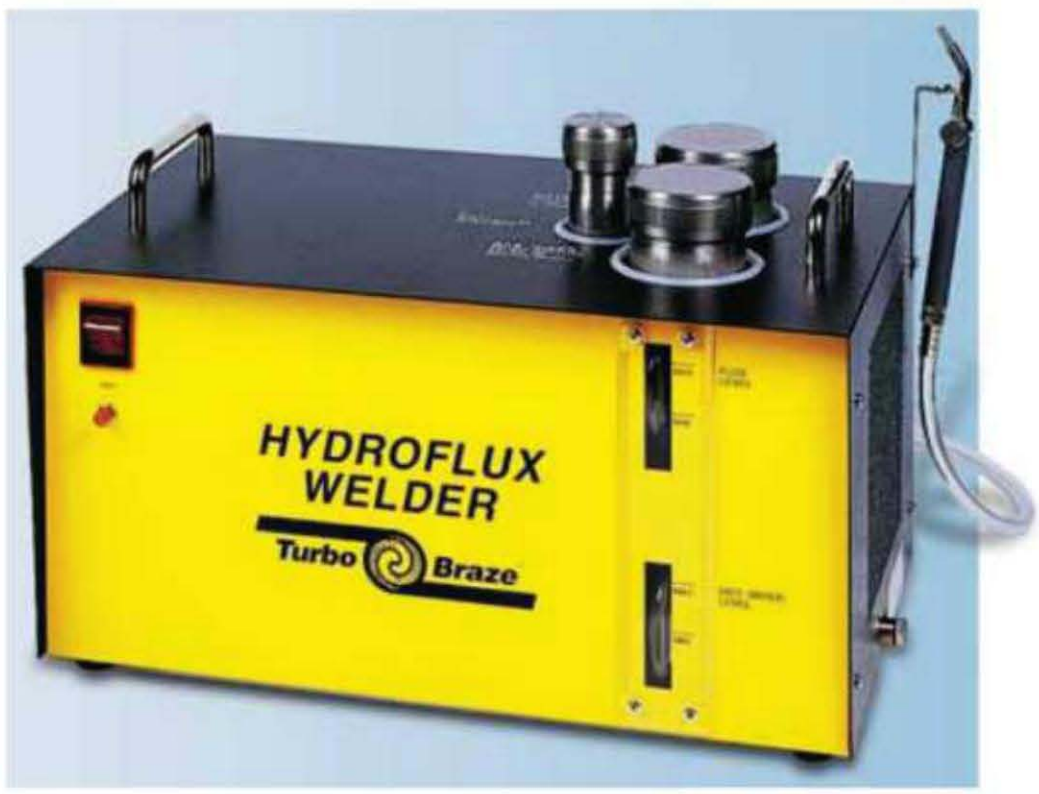
Oxy/Acetylene Torch & Oxy/Propane Torch

Both of these torch setups have two gas tanks, one for oxygen and one for gas (either acetylene or propane). Both tanks have a hose and fittings that screw onto the tank. The fittings display the amount of gas in the tank and the pressure at which the gas is to be released. Gas pressure for jewelry making should be between 5 and 10 psi (pounds per square inch). The hose from each tank joins together at the handpiece, which has knobs that control the amount of gas that comes into the tip. Both gases come out of the tip at the same time and are burned together. This creates a much hotter flame than can be achieved with an ambient oxygen torch.

Depending on the type of handpiece and tip you're working with, an oxy/propane torch (below, left) may not be hot enough for all metal applications. However, an oxy/acetylene torch (below), will provide sufficient heat for any operation. Acetylene burns hotter than propane, but is a dirtier gas. This means that when you burn acetylene alone, black soot will burn off the gas and float into the air, eventually causing a dirty workspace. Acetylene disperses into the air when released and not burnt, while propane gathers in "clouds" and is much slower to dissipate. This can cause problems when working with propane indoors. If the tank, hose, or fittings were to accidentally leak gas, there is some danger of the propane clouds combusting.

Water Torch

A water torch is great for working in an environment where you aren't allowed to have pressurized gases. This torch generates gas by electrolyzing hydrogen and oxygen atoms from an electrolyte solution by means of electric stimulation. The water torch burns hot enough for all soldering applications, but is quite expensive.



Torch Handpieces

There are three common varieties of handpieces for mixed-gas tank setups. For larger metal work, there is a welding and cutting handpiece. For small metal work, such as making jewelry, there are two common handpieces: the mini torch and the hoke torch.

Welding & Cutting Handpiece

This type allows a large amount of gas to be released from the tip and generates a flame that is hot enough to weld and cut steel. A welding/cutting handpiece is useful for annealing and soldering large metal pieces when an extreme amount of heat is required.

Mini Torch & Hoke Torch

The mini torch allows a very small amount of gas to be released from the tip and generates a very small flame. This handpiece is preferred for making jewelry because the small flame it generates is perfect for extremely localized soldering jobs. The mini torch is sold with a variety of tips that can be screwed on and off for very specific soldering jobs. The hoke torch is a bit larger than the mini torch and its flame does not get as small.

Lighting an Acetylene B with Ambient Oxygen Torch

PROCESS

TURN the knob on the handpiece counterclockwise, approximately one-quarter of a full turn.

You do not want to hear gas escaping in a rush while lighting the torch.

A good mnemonic for remembering how to turn on the gas is "Lefty Loosey, Righty Tighty."

IGNITE the gas coming from the tip of the torch with a striker.

A striker is a tool that makes a spark by rubbing a flint on a piece of steel.

ADJUST the size of the flame as needed by turning the knob on the handpiece counterclockwise.

EXTINGUISH the torch by turning the knob on the handpiece clockwise.

Lighting an Oxy/Acetylene or Oxy/Propane Torch

PROCESS

TURN the knob on the handpiece (for the acetylene or propane gas) counterclockwise about one-quarter of a full rotation.

SET the gas pressure on both tanks between 5 and 10 psi (pounds per square inch).

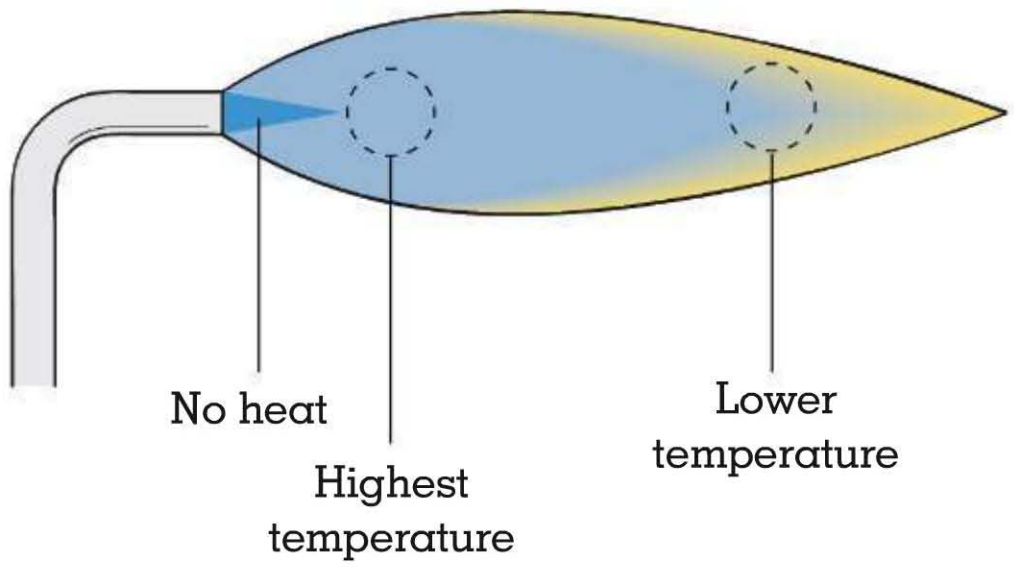
LIGHT the gas with a striker.

TURN the knob on the handpiece for the oxygen slightly counterclockwise to introduce a tiny amount of oxygen into the flame, and keep turning the oxygen knob counterclockwise until there is an even flame.

ALTER the size of the flame as needed to produce different amounts of heat.

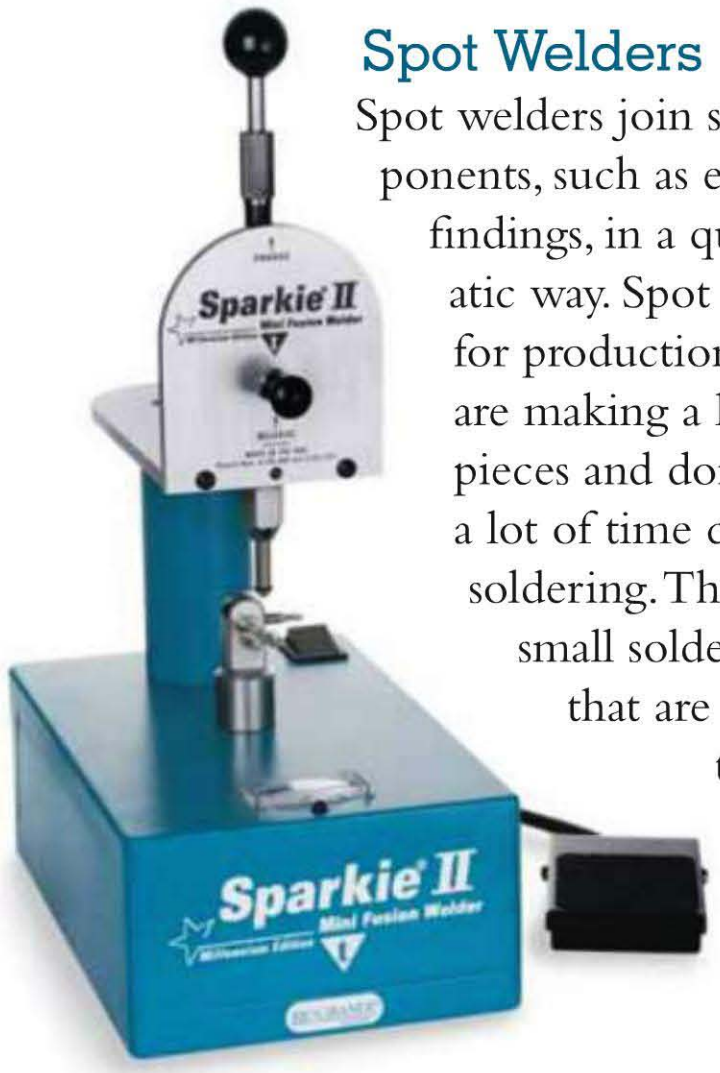
If you have a mini torch, turn off the gas and switch tips to vary the size of the flame and the amount of localized heat.

EXTINGUISH the torch by turning off the oxygen first (rotate the knob clockwise), and then turn off the acetylene or propane (rotate the knob clockwise).



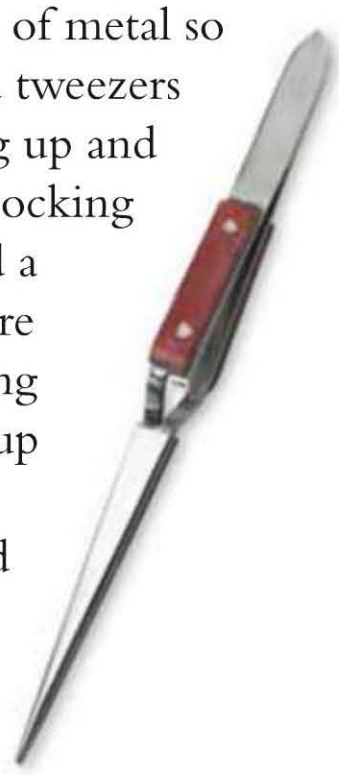
Spot Welders

Spot welders join small metal components, such as ear posts and pin findings, in a quick and systematic way. Spot welders are useful for production jewelers who are making a large number of pieces and don't want to spend a lot of time cleaning up after soldering. There are many small soldering machines that are spot welders, but these machines are not necessary for most metalsmiths.



Tweezers

Tweezers are a necessity when soldering. You will often use them to hold hot pieces of metal so you won't burn yourself. Standard tweezers (below) are well suited for picking up and moving small or hot parts. Cross-locking tweezers (right) allow you to hold a piece without exerting any pressure and tiring your hand. Cross-locking tweezers are excellent for setting up soldering operations. Simply rest them on a soldering block to hold a piece in position.



Third Hand

Some jewelers use a third hand in a soldering setup. This tool has a metal base with a screw lock that holds cross-locking tweezers in position, but it can be unnecessarily time-consuming in preparation and set up. For most operations, you can use cross-locking tweezers in one hand and use your other hand to hold the piece in place. The lack of restriction lets you move on to the next step quickly and easily.

Solder Picks

Solder picks can be made out of a variety of materials. Many jewelers use part of an old wire coat hanger with one end filed to a point. Others prefer titanium or tungsten picks that are specifically manufactured for soldering. Solder will not adhere to titanium or tungsten as easily as it will to the mild steel of a coat hanger. In addition, the handles on commercial solder picks help deter the heat of the torch, allowing you to hold them longer. Both types of picks will need to be cleaned eventually. File excess solder off the end of the pick and sand off any crystalline flux residue.

Soldering Techniques

There are three conditions essential to soldering:

1. **The metal elements must be clean.**
   - Clean metal is free of dirt, grease, wax, and oxidation.
   - Metal ordered from the mill is usually in good condition for soldering, unless it has been left out to oxidize for a very long period of time.
   - If the completed piece will have a shiny finish, you can clean the metal with a soft pumice powder before soldering. Otherwise, you can leave it with the manufacturer's finish.
   - Flux keeps metal clean while soldering. If metal is heated for too long, flux can burn off and will no longer protect the metal from oxidation.

2. **The metal elements must be touching.**
   - Do not try to "fill in" empty spaces with solder. This could leave pits in the solder, and the solder will have a slightly different color than the metal.

3. **The metal elements must be hot enough to melt the solder.**
   - Solder flows toward heat. If the solder is not flowing, there is not enough heat or the metal is too dirty.

Pick Soldering

The pick soldering technique uses a solder pick and snippets of solder to join metal elements. This method is especially effective when you need to carefully control the amount of solder you use, such as in the creation of neat, tidy joints. Pick soldering is also well-suited for joining small wires to sheet metal, for connecting wire forms, for small appliqués, for closing jump rings, and for attaching hinges.

PROCESS

POSITION the metal pieces on a soldering block so your hands are free.

APPLY flux to the area to be soldered.

HOLD the torch in one hand and the solder pick in the other.

DIP the point of the solder pick into the flux.

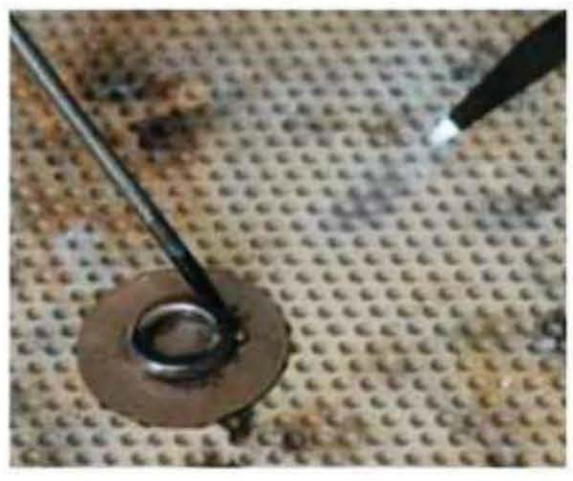
You shouldn't have to dip the pick into the flux every time you pick up a snippet. Once heated, the flux will hold the snippet on the pick, like sticky glue.

HEAT the flux at the end of the pick with the torch while touching the pick to a solder snippet.

MOVE both hands simultaneously—one holding the pick and one holding the torch—to the area to be soldered.

HEAT the area to be soldered until the flux is sticky and glassy.

DEPOSIT the solder snippet gently in place, using the heat from the torch to release the solder from the flux (above, right).



You can either individually position and melt snippets or arrange all the necessary snippets and then heat the whole piece to the appropriate temperature, melting them all at one time. With practice, you'll determine what method works best for you, based on the specific soldering operation you need to accomplish.

Pick-Up Soldering

This soldering technique is useful for joining small parts onto larger parts, such as attaching an ear post to an earring. Solder snippets are melted on the end of the small part, and then re-melted to join it to the larger part. This method can lessen the need for many complex setups.

PROCESS

PLACE the larger metal piece on the soldering block.

APPLY flux to the larger piece on the area to be soldered.

PICK UP the small piece with cross-locking tweezers.

DIP the end of the small piece into the flux.

HEAT the end of the small piece with your torch gently (below, left).

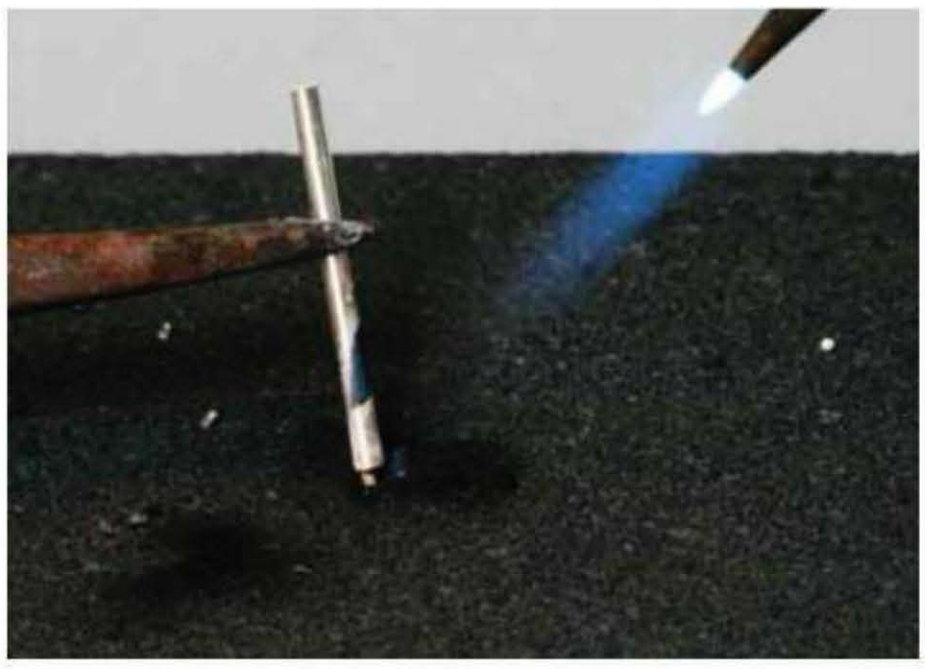
MELT a small solder snippet onto the small metal piece at the location it will be soldered.

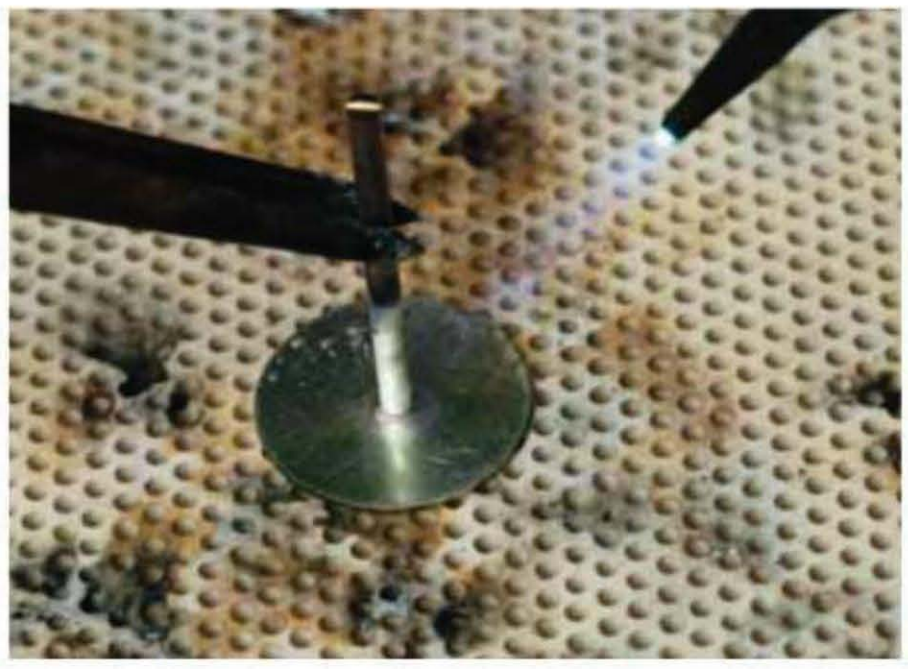
HEAT the larger piece of metal on the soldering block with the torch until the flux looks glassy.

POSITION the small metal piece onto the larger metal piece (below, right).

HEAT the metal pieces with the torch until the solder re-flows.

REMOVE the heat from the pieces.





Sweat Soldering

Use sweat soldering to join layers of sheet metal together. (Another term to describe this technique is appliqué.) Usually, the top metal piece is smaller than the one on the bottom. Several small pieces can be appliquéd onto one layer, or even several layers, of sheet metal.

PROCESS

PLACE the top layer of the metal appliqué on a soldering block with its backside facing up.

APPLY flux to the metal.

MELT a small amount of solder onto the backside of the metal appliqué.

Use hard solder if this is one of the first soldering applications on the piece. Use easy solder if it is one of the last.

SPREAD the melted solder around the appliqué piece with a solder pick, covering as much of the surface as you can with as little solder as possible.

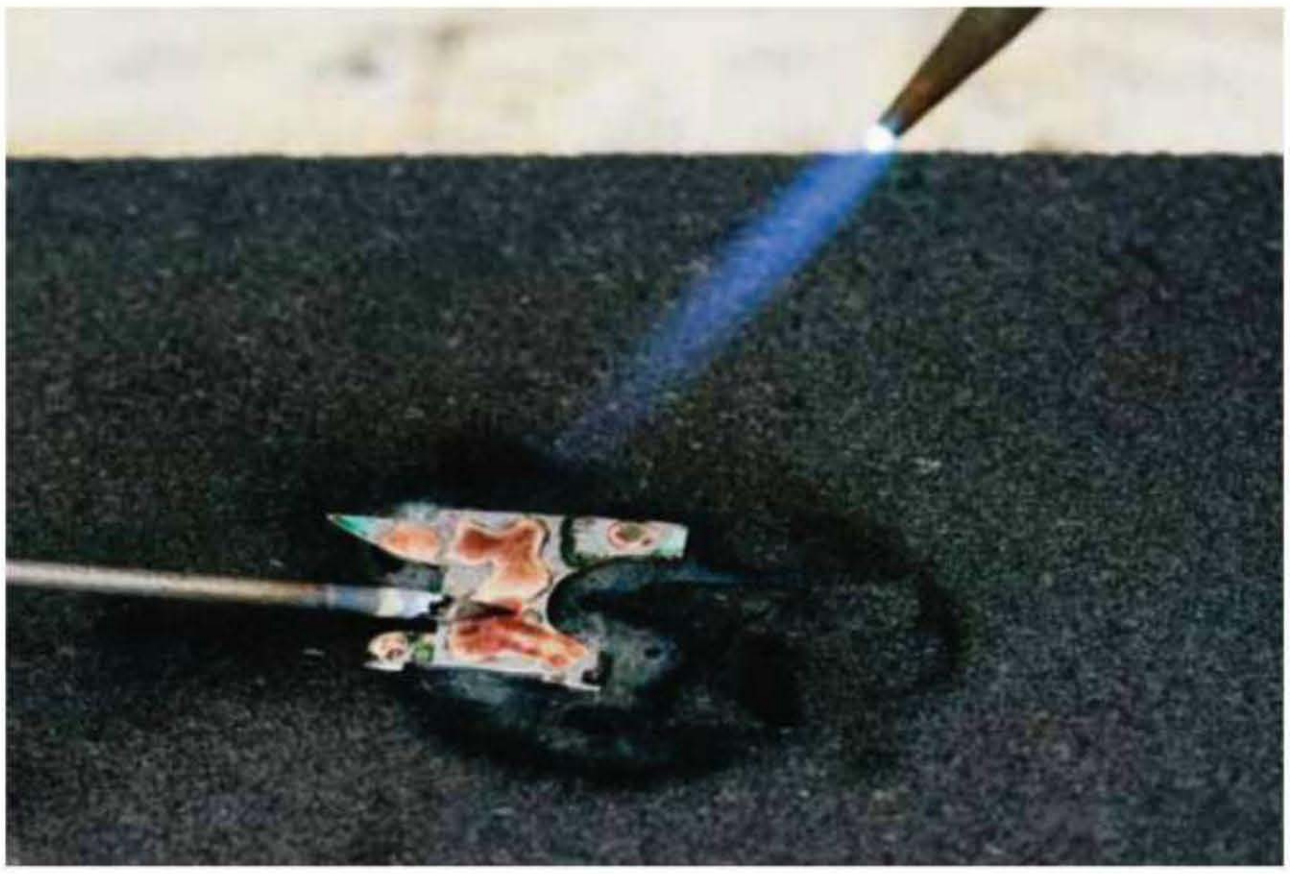
This step should be done at the temperature when the solder is viscous, not watery.

An alternative process is to sift powdered solder onto the appliqué. Some jewelers find this method more precise in distributing the proper amount of solder in an even coat.

PICKLE the metal appliqué to remove all flux and oxidation.

APPLY flux to the base metal layer and all appliqués.

OPTION 1
HEAT the flux on the base piece until it is glassy, stop heating the metal, and place the fluxed appliqué piece on the metal.



OPTION 2
POSITION the appliqué piece on the base piece, and then gently heat the piece.

With either option there is a chance that, when the flux becomes fluid, the appliqué will shift on the base piece. If the appliqué does move, gently reposition it with the solder pick while continuing to heat the piece.

AIM the torch from above, primarily directing its heat on the base (larger) metal piece, but occasionally waving the torch over the appliqué piece.

It is of the utmost importance to heat the metal layers to the same temperature in order for them to solder. To accomplish this, you must add extra heat to the larger metal piece, and avoid overheating the smaller one.

CONCENTRATE the torch's heat on the appliqué piece once the flux on the base piece begins to look glassy.

LOOK for a flash of brightness as the solder melts around the metal appliqué.

STOP heating the metal immediately when you see the flash of the melted solder.

Tips

• Some jewelers prefer to place the larger, base piece on a metal screen atop a tripod and heat the metal from underneath. This method does not allow you to see where the heat is and how the metal is reacting. It's much better to turn up the heat of the torch than it is to have the flame hidden, producing results you may not see and risking the success of your hard work.

• From the very beginning of the appliqué process, be careful with the amount of solder you use. Applying a thin layer that almost covers the back of appliqué works well. If you use too much solder, it will seep out around the edges of the appliqué and look messy, and there is really no way to clean this up. If you use too little solder, you can add more later using pick soldering. Keep in mind that this option is a little tricky and can also be messy if the heat from the torch is not concentrated in the right area.

Correct amount of solder

Too much solder

Stick Soldering

This technique uses wire solder to join metal pieces. Stick soldering is often used for hollow forms, for large appliqué, and for certain types of complex filigree. It's ideal for operations that require a large amount of solder that can later be hidden inside a form or cut away. Usually, stick soldering is not particularly precise or neat, but it can be a very quick method that saves you a lot of time.

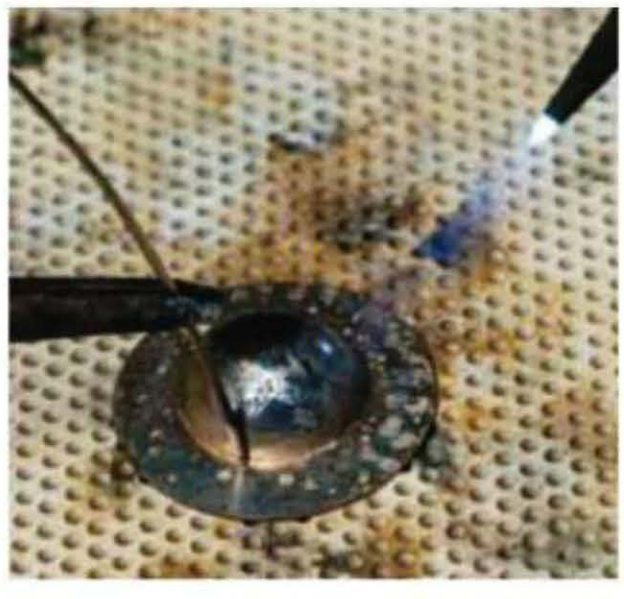
PROCESS

POSITION the metal pieces on the soldering block so you will be able to hold the torch in one hand and the stick solder in the other.

CUT a piece of wire solder from the coil that is approximately 8 inches (20.3 cm) long.

During soldering, when the stick of solder gets too short and too hot to hold in your hand, use wooden-handled cross-locking tweezers to hold it.

HEAT the metal piece to soldering temperature with the torch. You can check the metal's temperature by gently touching the solder to the piece to see if it melts. If the solder does not melt on contact, then the piece is not hot enough. Continue heating and checking the temperature until the solder flows easily when touched to the metal.



TOUCH the solder very lightly to the metal you want to join.

Stick soldering requires a light touch. Do not poke the solder at the metal, because this will cause it to move out of place. Sometimes, you may release a small blob of solder onto a joint. This is fine, as long as you melt all the solder cleanly and are not left with a lot of filing, grinding, and sanding to do later to fix it. A blob of solder can even be useful when you have a large area to join.

Forming Techniques

Forming metal means altering the initial shape of the material. There are many forming techniques, all of which are open to experimentation and interpretation. Forming utilizes the inherent malleability of metal to make new interesting shapes.

Forging

Forging alters the thickness and shape of metal through the force of hammer blows. By applying this force from different directions, the metal can be stretched or condensed. The metal being forged must be placed on a sturdy metal surface, such as a stake or an anvil, for support and resistance. Specific forging processes require the use of specialized forming hammers.

The most basic forging techniques include tapering the length of square or round wire, and widening a piece of stock metal. Both ways of moving metal are performed in a calculated and controlled manner.

The technique of planishing uses a planishing hammer to remove all forging marks and make the metal surface as smooth as it can be. Planishing does slightly stretch the metal, so take this into account when determining when to stop forging.

Sinking hammers

Forging Metal Bar

Practice your forging skills on a square or round piece of copper bar stock that is 5 or 10 mm thick.

PROCESS

ADJUST a chair to the proper height in relation to the height of the anvil—your forearm, wrist, and hammer should all be in alignment, with room left for making hammer blows.

If this position does not feel relaxed, and you begin to ache after hammering, readjust the chair.

PUT on hearing protection.

HOLD the hammer so it will move freely within your grip and your hand will feel relatively stress-free.

If you are using unnecessary force, your wrist and arm will begin to ache, so ease up and let yourself relax.

BEGIN making hammer blows at the place where you want the metal to stretch, letting the weight of the hammer do all the work.

Make your hammer blows count. The metal will move with each blow, so precision is necessary.

To taper the metal, position the face of the hammer perpendicular to the length of the bar (above, left).

To widen the metal, the face of the hammer should be parallel to the length of the bar (above, right).

ANNEAL the metal as soon as the hammer blows make a pinging sound instead of a dull thud.

DRY the metal thoroughly after annealing to prevent the anvil and hammer from rusting.

PLANISH the metal once it's close to being sufficiently tapered or widened.

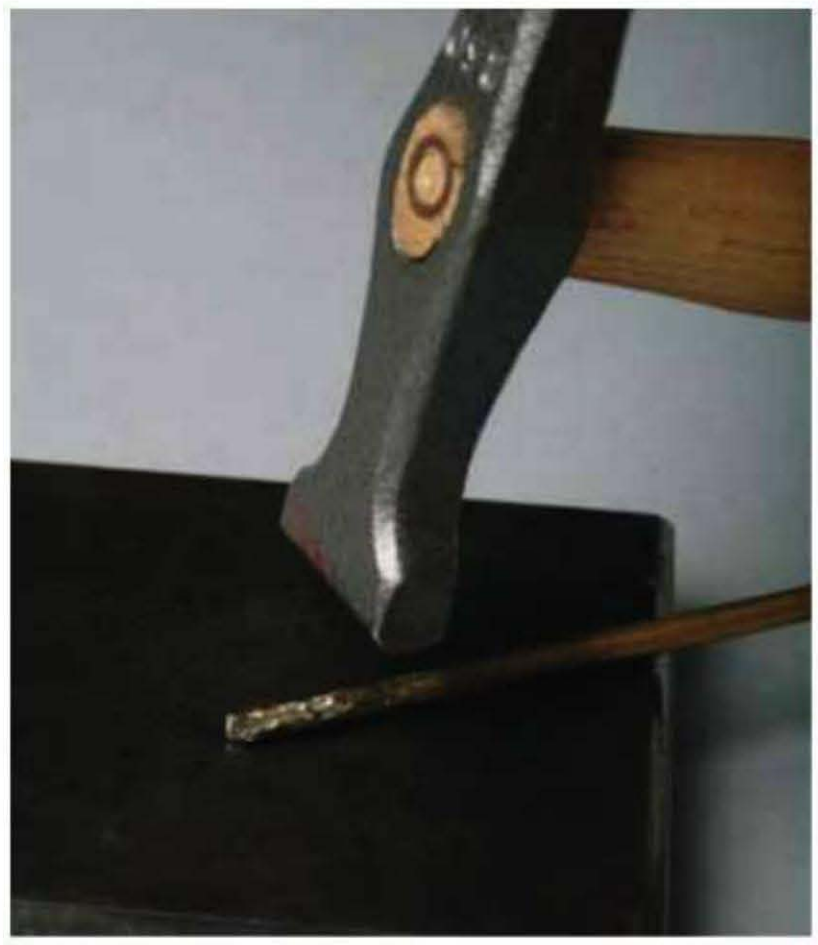
OPTION To completely clean the forged stock, file off any facets (bumps made from the planishing hammer), and then sand the piece with 220- and 400-grit sandpaper.

Tips

• If a square bar becomes rectangular while being tapered and you want it to remain square, turn the bar 90° and continue hammering to re-square the metal.

• When tapering a round bar, it is helpful to first stretch the metal and form it into a square. Then, go back and hammer the square corners until the edges are curved and the bar returns to its round shape (see photo, right).

• If you've widened metal in a curved fashion, you may need to clean up the curve with a file. Experiment to see what results you achieve when you hammer directly on the thin edge of the curve. You can thicken the edge of a forged piece by lightly and directly hammering the edge at a 90° angle.



Dapping

Dapping sheet metal produces dome shapes that are useful in many jewelry applications.

PROCESS

SAW out a sheet metal shape to be domed.

SELECT a depression in the dapping block with the appropriate depth and curvature for the dome to be created, and place the sheet metal shape in the selected depression.

If the metal is too large for the depression, choose another depression in which the metal fits, close to the desired dome size.

CHOOSE a dapping punch that closely fits the size of the selected depression.

USE a mallet to gently hammer the punch into the depression, forcing the metal down.

To ensure that the metal stretches evenly and its surface is evenly domed, aim the punch at the edges of the metal first (see photo, left), and then carefully move the punch into the center of the metal. In many cases an uneven stretch is inconsequential, but in some situations, such as when stones are set in the domed metal, uniform thickness is important.

MOVE the metal to the next smaller depression in the block, select the proper punch, and continue dapping to form a dome with a tighter curve, repeating this step as needed to achieve the desired dome.

Dapping a Half Sphere

Dapping a perfect half sphere from a metal disk is a little tricky. You must use dapping punches that are smaller than the size of the depression.

PROCESS

DAP a dome with a small punch until it seems as if the dome might form around the head of the punch.

MOVE the metal to a smaller depression and use a smaller punch until a perfect half sphere is achieved.

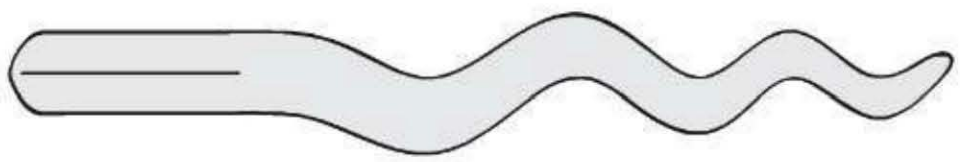
MEASURE the dome with calipers to determine whether a true half sphere has been created. (The height of the dome should be exactly half of its width.)

Sinking

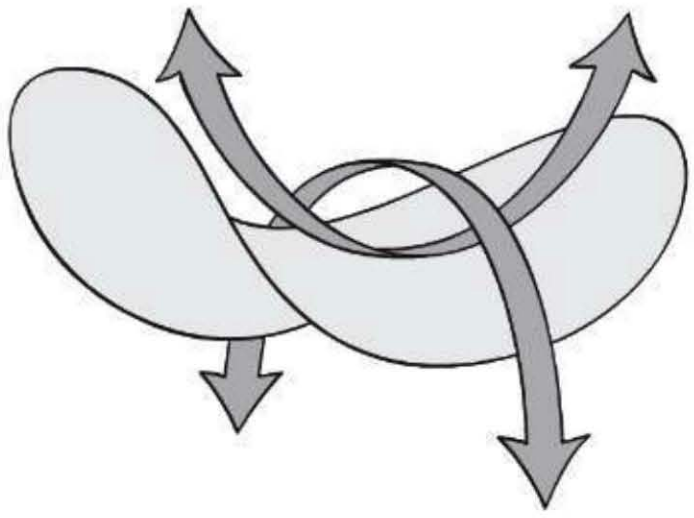
In the sinking process, metal is pushed down into a depression of some kind to alter its shape. Usually a hammer or a metal or wood dap is used to push the material into a sandbag or a depression carved into a wooden stump. (Historically, smiths sunk metal into a block of lead.) Sinking stretches the metal into shape through resistance. The resistance comes either from the substance resting underneath the metal or from the inherent resistance of the metal in combination with the pressure coming from above. Sinking stretches metal from a downward force, which is the reverse of the raising process. Raising stretches metal over a metal stake with repeated hammer blows, a technique usually reserved for larger objects, such as hollowware.

Anticlastic Forming

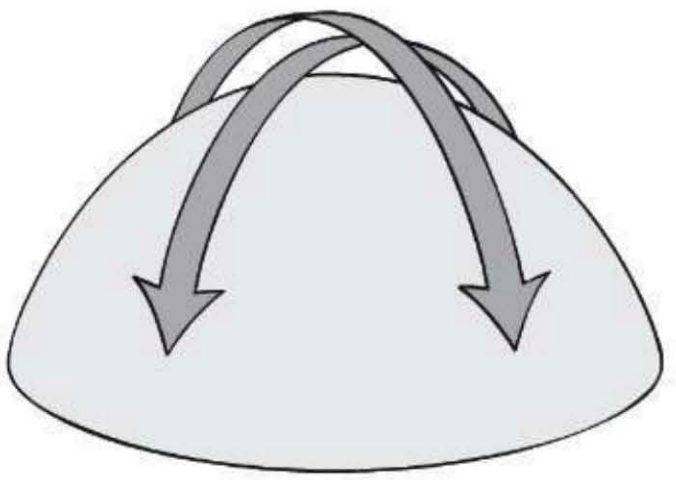
The anticlastic forming process uses a sinusoidal stake. Using this specialized tool, metal can be simultaneously stretched into two curves that are at right angles to each other. For example, a flat ring would be hammered into a doughnut shape, where a flat piece of metal would be hammered into a saddle shape. Synclastic forming, on the other hand, describes a form in which the dominant curves both move in the same direction, such as a bowl.



Sinusoidal stake



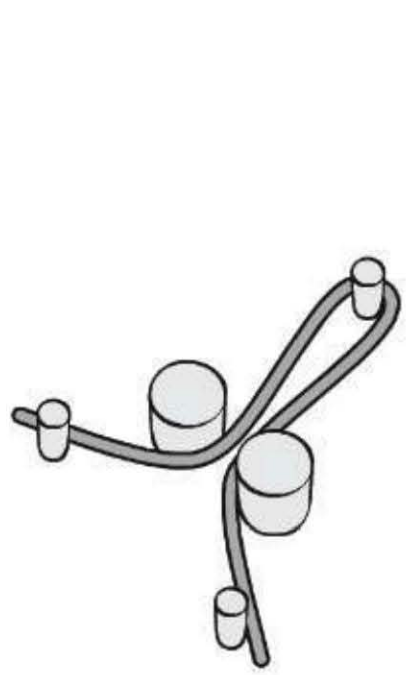
Anticlastic forming



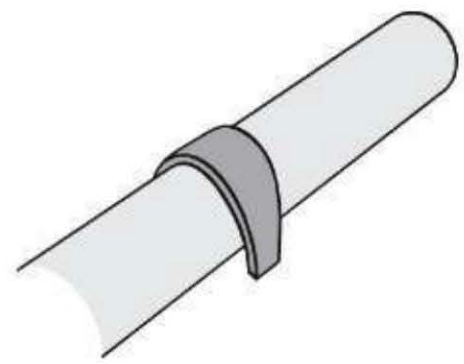
Synclastic forming

Bending

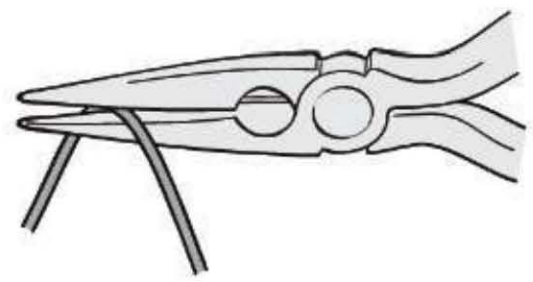
In bending, shapes are made from a flat plane of metal. The process can be done in a variety of ways, both controlled and free-form. Metal can be bent with your fingers or pliers, around a jig or a mandrel, or in a bending block.



Bending in a jig



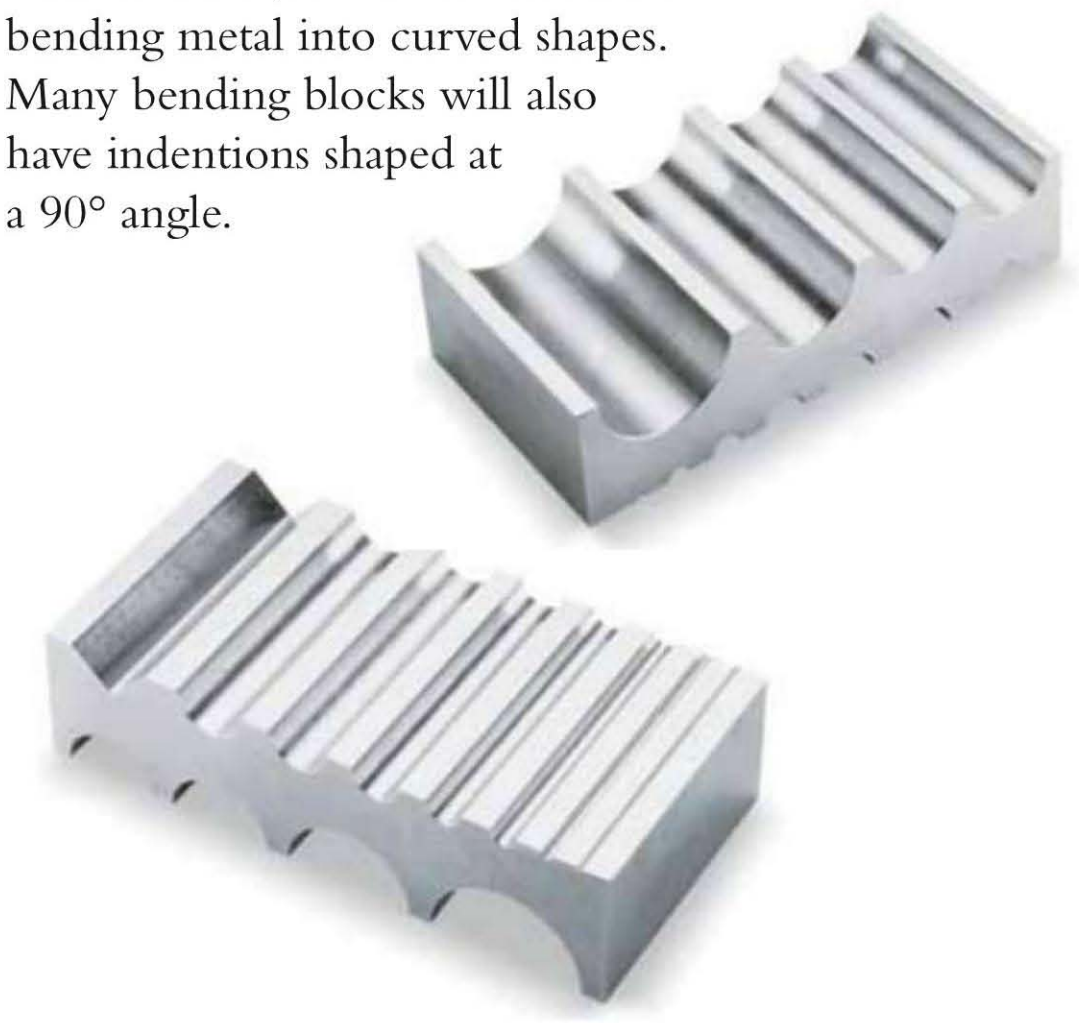
Bending on a mandrel



Bending with pliers

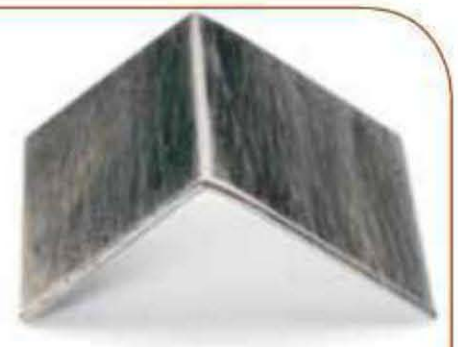
New Tool

A bending block, made from either steel or wood, is used as a resist for bending metal into curved shapes. Many bending blocks will also have indentions shaped at a 90° angle.



Scoring & Bending

Although there are many ways to bend sheet metal and wire into angles, there is one way to make a sharp angle that is unsurpassed. This technique is called scoring and bending. As shown in the photos at right, you can reduce or increase the angle of the bend by filing away more or less metal at the score line.



PROCESS

CUT the sheet metal or wire to the desired dimensions with a jeweler's saw.

DETERMINE the placement of the angle and use a scribe and straightedge to draw a line on the metal at this location.

RETRACE the line with the scribe, deepening the line in the metal.

This will be the guideline for filing, so the deeper it's scribed into the metal, the better.

HOLD the metal firmly on the bench pin and use one corner of a square file to slowly and strongly file the scribed line into a 90° groove that very nearly penetrates the metal surface.

As you carefully file the groove, frequently turn over the metal and check for the appearance of a thin line on the reverse side (see photo, below). This is a visual indicator to stop filing. If the metal is filed too much, it could break when it is bent.

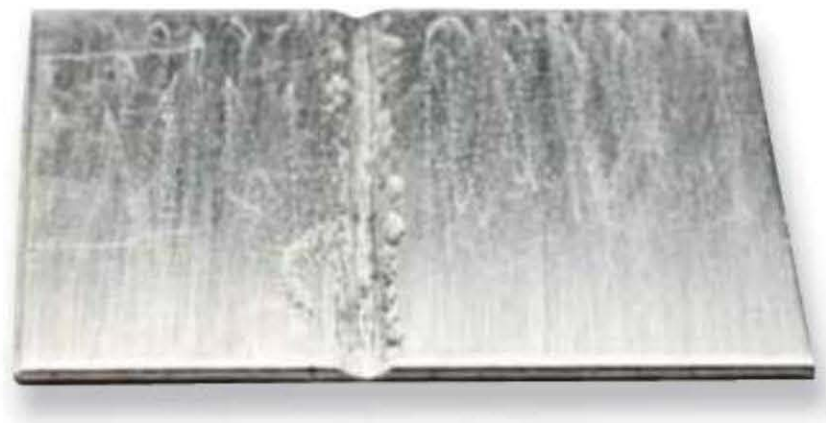
BEND the metal into an angle with your fingers once the thin line appears on the reverse side.

You may only have one chance to bend the metal into the proper angle. If you attempt to bend the metal back and forth, the thin surface remaining in the groove will work harden and the metal will snap into two pieces.

SOLDER the joint to secure the bent metal, using a small snippet of hard solder so the line remains clean.

Scoring with Separating Disks

When making hollow forms that require sharp angles, grooves can be quickly cut with a separating disk attachment on a flexible shaft. This alternate method is quite useful when making multiple sharp bends, especially when crisp, perfect angles are not the main goal. It is, however, a risky process because a separating disk attachment is often harder to control than a needle file. Safety goggles must be worn whenever you're using a separating disk. This attachment is notorious for breaking easily, and it can cause serious harm to your eyes.



PROCESS

SCORE a deep straight line down the metal with a scribe.

USE a separating disk attachment on a flexible shaft to gently remove metal along both sides of the scored line, creating an angled groove.

BEND and solder the joint as usual.

Tip

You can carve a curved line with the separating disk as well.

New Tool

Separating disks are used with a screw mandrel in the flexible shaft. These 1-inch (2.5 cm) disks are made with carborundum, an abrasive substance that removes metal.

Making Tubing

To make tubing from sheet, you will need a steel drawplate, a round mandrel or a forming block, and a wooden or plastic hammer. You can also start by making tubing with a large diameter, and then draw it down to a smaller diameter later.

PROCESS

DETERMINE the wall thickness, the outside diameter, and the inside diameter for the tubing.

DETERMINE the width of metal needed to make the tubing by calculating the circumference of the desired tubing.

Circumference = Pi x Diameter

This formula works for metal sheet that is 1 mm thick or less.

For thicker tubing walls, add the thickness of the sheet to the total circumference.

CUT the metal sheet to the desired width and length with a jeweler's saw, leaving a long triangle at one end.

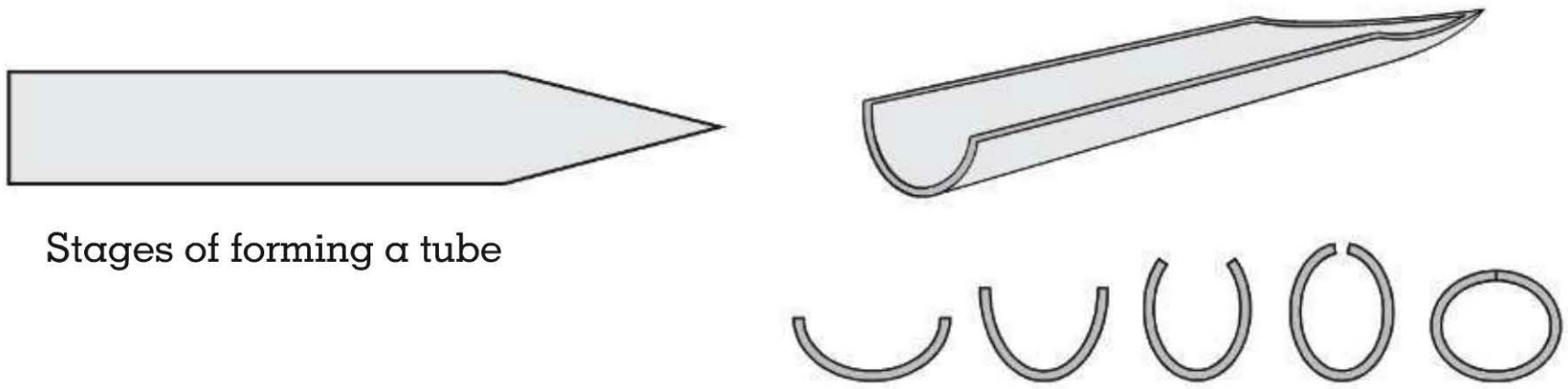
The long triangle will be used as a tang for drawing the tubing through the drawplate. This material will be cut off after the tubing has been made.

BEND the sheet around a mandrel or in a forming block.

Once curved, you can begin drawing the sheet through the drawplate.

SOLDER the joint with hard solder when the curved sheet has become a complete circle.

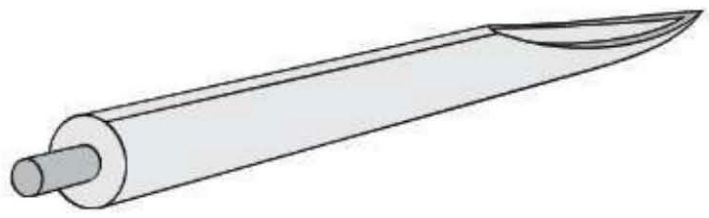
Soldering will also anneal the metal, making it easier to draw through the drawplate to the desired diameter.



Stages of forming a tube

Tip

When the inside diameter of the tubing needs to be a very exact size, insert a solid wire core into the tube before drawing the tubing down. Stainless steel wire works best for this process. Do not draw the tubing down very far or the wire will get stuck inside the tubing.

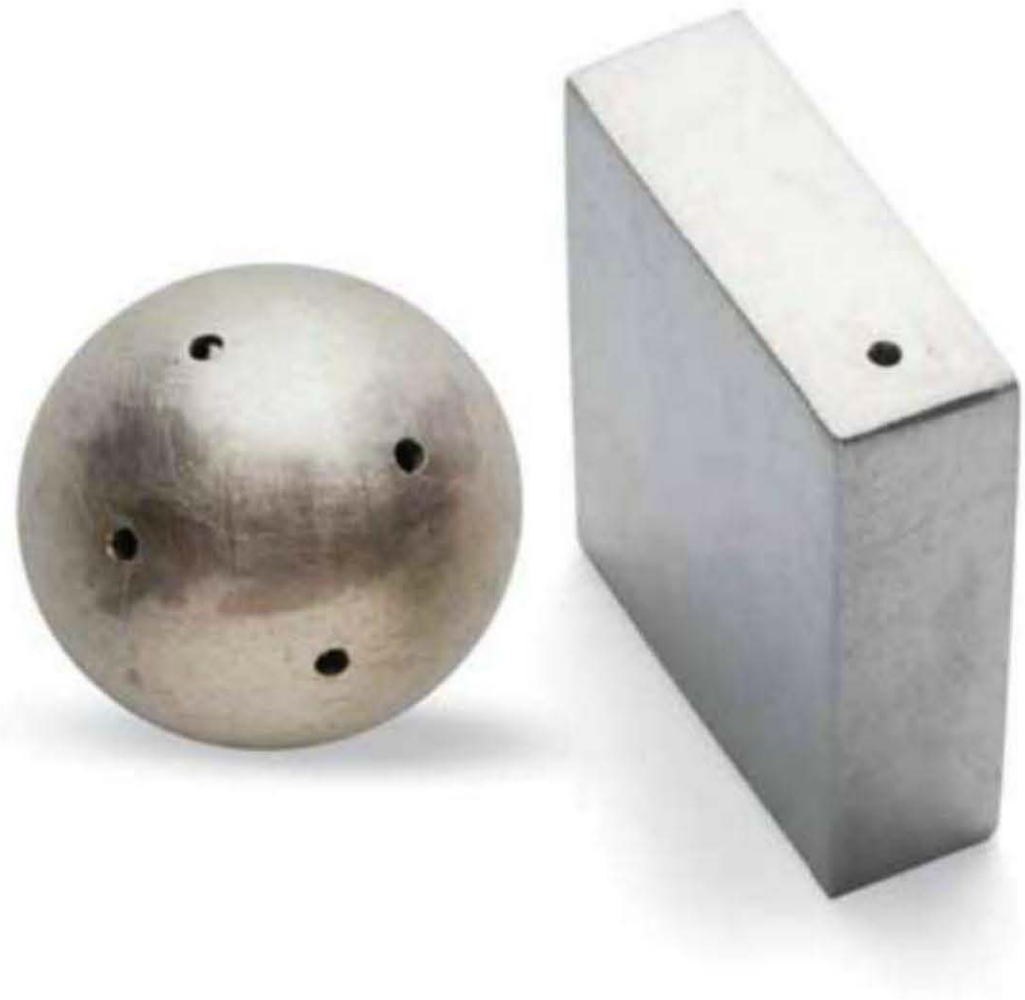


Hollow Forming

Hollow forming is any fabrication technique that produces a hollow structure, such as a cube or a box. The advantages of hollow forms, as opposed to solid forms, are that they can have a large surface area while remaining light and wearable. Hollow forms also use less metal than solid forms, and are thereby less costly to make. There are countless ways to make hollow forms. Two simple methods would be soldering a die-formed shape onto a flat sheet and soldering two domed spheres together.

Air Hole Considerations

An important consideration when planning to construct a hollow form is whether or not to make an air hole. When a form with a hollow core is completely soldered, a vacuum develops inside the form. There is no air present inside the hollow space. However, if solder joints are not perfect, miniscule holes may be present. These holes can let in air or moisture. The moisture is often introduced when the soldered piece is put into pickle. The pickle seeps in through the tiny hole or holes. This is not a huge problem for a hollow form unless further soldering is required. If moisture is present in the hollow form and heat is applied to it, the moisture will expand inside the form, eventually creating a small bomb. The expanding moisture must have a place to go, so the seams of the form will blow open forcefully, creating an almost deafening noise, and often launching the very hot metal piece across the room.



To avoid this extremely dangerous outcome, drill a small hole in the hollow form to let the moisture escape. Drill the hole in an inconspicuous place or use the hole as part of the design. This is the safest practice by far, but it does have a catch—moisture will definitely get into the hollow form at some point, and it will have to be removed. To do so, position the piece so that its air hole points away from you, and then gently heat the piece with a torch until the moisture squirts out. Let the piece air cool, and do not place it back into pickle or water.

It's possible to create a hollow form without an air hole. After constructing the form, inspect all solder joints to make sure they appear tight. After removing the piece from the pickle, feel its weight to judge whether or not it took any fluid into the hollow space. If the pickle is hot, feel the piece to see if it seems hot, like it is full of hot pickle. If the piece feels light and cool, it is most likely tight and safe. When performing another soldering operation, carefully watch the hollow form. If it seems to rock and wiggle for no apparent reason, immediately stop heating the piece, let the piece cool, and then drill an air hole to let out any moisture or to simply be on the safe side.

Gauge Considerations

When making a hollow form, another important variable to consider is the thickness of the sheet metal. Thin metal gauges can be used for small forms, but for larger hollow forms, thicker metal gauges are required for strength in spanning a distance. If thin metal is used on a large form, the sheet may sink into the hollow area once it is annealed after soldering. There is no formula for determining the proper gauge for making a hollow form. You must select a sheet based on your experience. For most metals, 22- or 20-gauge sheet is a good starting point. Cost of material, especially for silver and gold, is also a factor to be considered when determining what gauge to use.

Die Forming

You can create an infinite number of three-dimensional metal forms and shapes through die forming. This technique uses a hydraulic press to push metal into a prescribed shape.

New Tool

A hydraulic press is a mechanical devise that applies an even, compressive force. It is used with dies to form metal.

Making a Die

Most jewelry-making dies are made of ⅛-inch-thick (3 mm) steel or ½-inch-thick (1.3 cm) acrylic and are no larger than 4 inches (10.2 cm) square. This size fits the hydraulic press and is easy to use. Die form 20- to 26-gauge sheet metal. If making an extremely deep form, use the thicker metal. If the metal is to have a fairly low dome, use thinner metal.

Spiral saw blades used for sawing acrylic or wax

PROCESS

CREATE a design and scribe it on the die, leaving a margin of approximately ¾ to 1 inch (1.9 to 2.5 cm) between the edge of the design and the edge of the die.

DRILL a hole in the interior of the design (the negative space to be cut out of the die), using a bit large enough to accommodate the saw blade.

SAW out the negative shape, making sure to hold the saw frame at a 90° angle to the die.

FILE the cut edges of the design, and then sand the edges to a 220-grit finish.

Make sure the top edge of the cutout shape is not sharp, especially on a steel die.

Tips

- Some hydraulic presses have a pressure gauge. This feature can be extremely useful in determining the amount of pressure needed to make matching die forms. Record the pressure-gauge reading of a successful die form in a notebook for future reference.

- Using a hydraulic press with no pressure gauge requires a lot of trial and error, and you will likely have many mistakes. Apply pressure slowly in order to save material.

- If you hear a fairly loud pop when depressing the hydraulics, it might mean that too much pressure has been applied and the metal has stretched and literally popped open (see photo, below). If you don't have a pressure gauge, make an effort to remember the force it took to reach to that stage, and avoid repeating it.

- To achieve an especially deep form, take the metal out of the die during the forming process and re-anneal it. This gives the metal more room to stretch without popping.

- Experiment with different types of rubber. Rubber dealers often sell assorted scrap materials by the pound.

Die Forming Metal

A hydraulic press uses 20 tons of force to press rubber and sheet metal into the die shape to form the metal. The rubber can be of different hardnesses to help achieve the desired amount of poof. In addition, you have control over how much pressure you choose to use from the hydraulic press in order to achieve the shape you like.

PROCESS

CUT the sheet metal into a square that is larger than the design but smaller than the die.

Extra metal is needed around the edges of the design because, when the metal is pressed, some of it is pulled into the cutout area to create the depth.

ANNEAL the sheet metal, and let it dry.

POSITION the sheet metal on the die.

Tape the corners of the metal to the die if desired, but note that the tape can leave a sticky residue that must later be removed.

PLACE the rubber on top of the sheet metal, and place the whole stack on the hydraulic press.

Depending on the press, you might need to place a small steel sheet on top of the rubber before placing the stack in the press. Experiment with types of rubber as well as using multiple rubber sheets.

PUMP the hydraulic press to press the rubber into the die.

RELEASE the pressure and check the metal as soon as you feel the action of the press firming up and becoming more difficult to move.

If the depth of the design is insufficient, replace the stack in the press and continue pressing until the desired depth is achieved.

REMOVE the formed metal from the die.

Texturing Techniques

What do the techniques of chasing, roller printing, etching, repoussé, and granulation have in common? They are all methods of producing texture on metal. Creating depth and dimension enhances metal's naturally luminous surface and thoughtfully applying these methods can enrich your jewelry designs.

Hammer Marks

Hammering marks left on metal can be used to create interesting textures. Use hammerheads in their original state or alter them to make unique surfaces.

Altered hammers for texturing metal

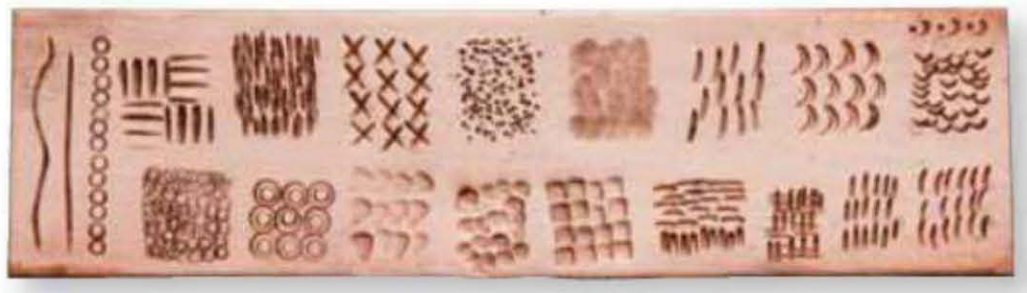
Sample hammer textures

Tips

- Use the round end of a ball peen hammer to make indentions that are as dense or as sparse as you like.
- Use the flat head of a distressed hammer to create a random texture. (To distress the flat hammerhead, file it or even pound it on a pile of sharp rocks.)
- Chase the end of a mild steel hammer, and then transfer those marks to the metal surface with hammer blows.

Chasing

Chasing is a technique in which steel hand tools are used with a chasing hammer to imprint metal. It is an excellent form of jewelry embellishment that can be used liberally, as the central focus of a jewelry design, or sparingly, for added interest or texture. Chasing can appear similar to engraving, but the processes differ substantially. Engraving actually removes metal from the surface, while chasing simply moves metal.

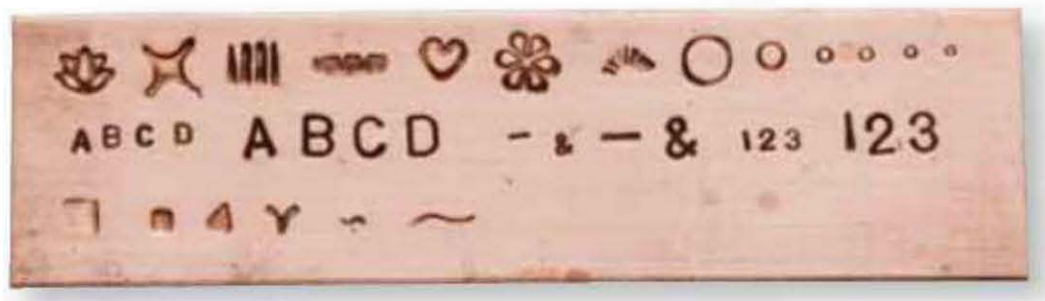


Chasing Tools

Chasing tools are made from tool steel, usually round or square stock, and can have unlimited designs. You can buy commercial chasing tools or make your own by carving the end of the tool with a shape or a texture, and then hardening and tempering the steel to make the carved design permanent.

Stamps

Some chasing tools are called stamps. The stamp design is not carved into metal, as with chasing, but imprinted on the metal through the force of hammer blows.



Liner Tools

A liner tool makes lines and curves on a metal surface and can be used to create intricate linear forms and designs. This chasing tool makes marks that are most similar to engraving.

Matting Tools

A matting tool is another variety of chasing tool. When hammered, a matting tool leaves a texture on the metal instead of a particular line design.

Stamping

Use this technique to add a complete image using only one tool.

PROCESS

PLACE a piece of sheet metal on a steel block.

TAPE the metal to the block to keep it from moving.

Do not apply any tape where you want to imprint the metal, as the tape will prevent the stamp from doing its full job.

POSITION the stamp on the metal surface.

HAMMER the top of the stamp with a chasing hammer, concentrating the blows at the 12-, 3-, 6-, and 9-o'clock positions.

Do not move the stamp as you hammer, but rock it around so the metal will receive a full imprint.

It is highly unlikely that one, big hammer blow will result in a good stamp impression exactly where you want it, so don't be tempted.

Chasing a Shape or Texture

Use this technique to make patterns or more complicated designs.

PROCESS

PLACE a piece of sheet metal on a steel block.

A steel block is essential to this process because it provides resistance to the hammer blows. Otherwise, the metal can become deformed and the chasing tool won't work properly.

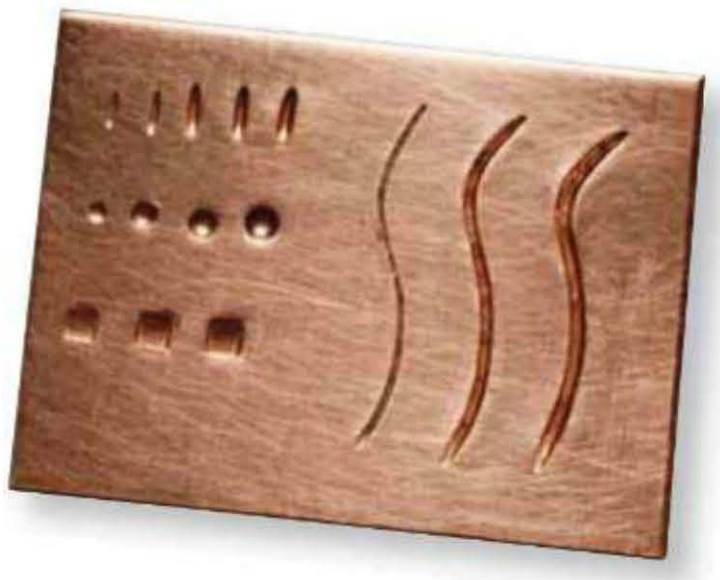
OPTION Tape the sheet to the steel block to secure the metal.

Some jewelers prefer to perform extensive chasing in pitch (see page 85).

POSITION the chasing tool on the metal and hold it in your fingers.

TAP the top of the tool lightly with a chasing hammer to make an impression on the metal sheet.

If desired, experiment on a scrap of sheet metal first. Make light and hard hammer blows and examine the different marks they make (see photo).



A chased metal sheet may become slightly domed because the metal molecules have been moved. The metal is thinner where the chased impressions have been made, forcing molecules toward unchased areas.

TURN over the sheet on the steel block so the chasing faces down.

HAMMER the surface lightly with a wooden or rawhide mallet to flatten the chased metal without leaving hammer marks.

This flattening process may need to be repeated several times during one chasing session. You may need to anneal your metal if this happens often.

Chasing a Continuous Line

Use this technique to make a line drawing in metal.

PROCESS

PLACE a piece of sheet metal on a steel block.

TAPE the sheet metal to the steel block to secure.

REST the liner tool lightly on the surface of the metal and hold it in your fingers.

You'll use your thumb and middle finger to guide the liner tool in the desired direction.

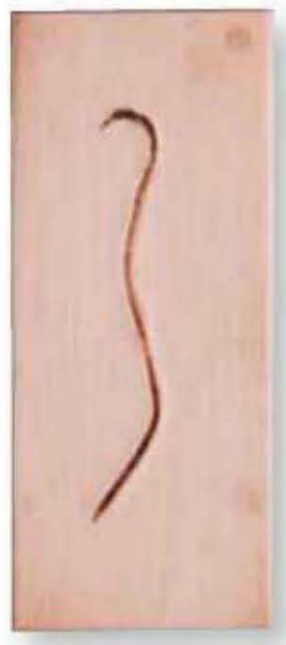
MAKE gentle blows with the chasing hammer on the end of the liner tool, while moving it along the line to be chased.

Do not pick up the liner tool between hammer blows. Hold the tool steady on the metal surface and make continuous and fairly rapid blows. The indented line should appear smooth rather than choppy.

If you need to take a break, make sure to resume chasing with the liner tool resting near the end of the last mark made, otherwise the line will appear broken.

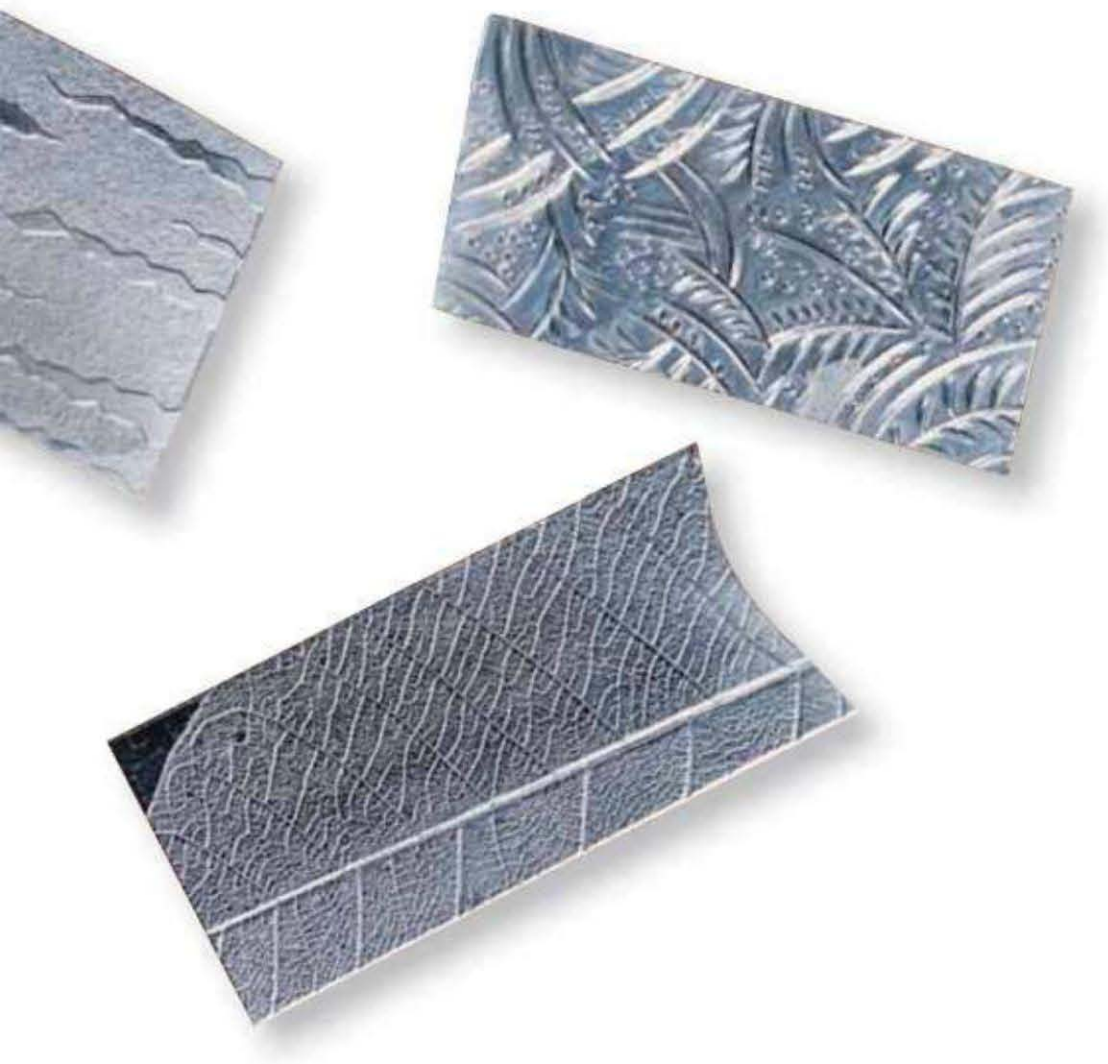
Tip

A straight liner tool is satisfactory for chasing loose curves. However, you may need to use a curved liner tool for chasing more tightly curved lines. With practice, it's possible to create a continuous line while switching back and forth between straight and curved lining tools.



Roller Printing

This technique uses the pressure of a rolling mill to transfer texture from a source material onto a metal surface. This process works best on an annealed sheet because the metal is soft and readily accepts the imprint.



New Tool

A rolling mill uses pressure to make metal sheet or wire thinner. Two parallel rollers are moved closer together to flatten the material. Some models are flat while others have grooves for sizing square and half-round wire. A rolling mill is required for a variety of techniques, such as roller printing (transferring texture) and lamination.

Roller Printing Metal

Be creative with your design source. Very subtle textures can alter the surface of metal in interesting ways.

PROCESS

TRIM the sheet metal to fit into the flat area on the rollers of the mill.

ANNEAL the metal to be printed.

LAY the design source on top of the sheet metal.

If using a ferrous metal design source such as steel screen, cover it with a nonferrous metal top sheet to protect the rollers on the mill from damage. A top sheet is not needed if the design source is not metal, although it's always a good practice to sandwich the design source in between two layers of nonferrous metal.

OPEN the rollers on the mill until the metal "stack" (the sheet or sheets of metal and the design source) fit snugly between the two rollers.

REMOVE the metal from the mill.

TURN the handle on the mill one-half of a revolution to move the rollers closer together.

Depending on how deep an imprint you wish to make and your design source, you may need to experiment with turning the handle more or less than half a turn.

ROLL the metal stack through the mill.

The handle should be somewhat difficult but not impossible to turn.

REMOVE the metal from the rolling mill and open the stack to see the imprint.

Before using the printed metal, you'll probably need to re-anneal the sheet and hammer it flat with a wooden or rawhide mallet.

Reticulation

Reticulation is a technique that creates a free-form sculptural texture on sheet metal. In essence, it's the controlled melting of the surface of sheet metal. With practice, reticulation patterns can be anticipated and managed leading to surface textures that are interesting and satisfying.

There is a variety of silver manufactured specifically for reticulation. If you plan to use this technique often, purchasing this particular type of silver is a good idea.

Reticulating Metal

Reticulation works best on sterling silver or gold. Using a thicker gauge of sheet metal allows for more hills and valleys in the reticulation. All reticulation should be completed before using the sheet in a piece of jewelry.

PROCESS

PLACE the metal sheet on a flat soldering block.

LIGHT the torch and create a medium hot, bushy flame.

HEAT the metal slowly and evenly, as if annealing, until ridges form on the sheet.

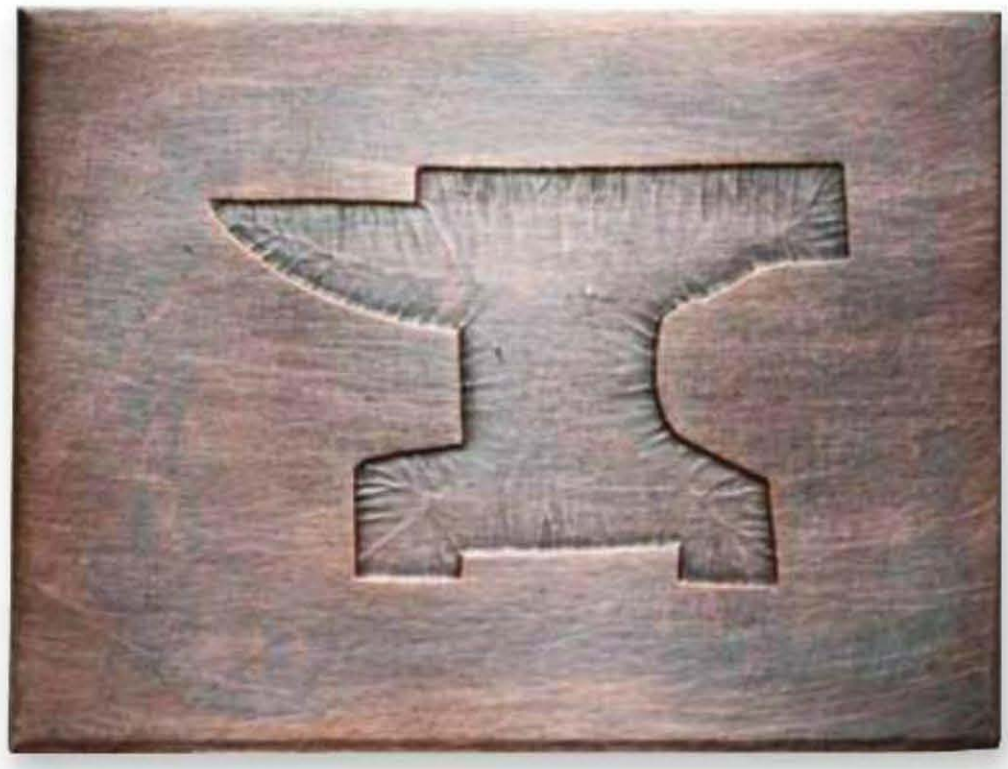
Be extremely careful not to overheat the metal in one area—a hole will suddenly burn in the sheet.

CONTINUE heating the sheet until the desired amount of creases forms.

Etching

The etching process uses a mordant, or acid solution, to eat away metal, leaving a relief design on its surface. A resist material shields areas from being eaten by the acid. Depending on the type of design to be etched, there are many different resists you can use (see photo, below). Popular resists include asphaltum, contact paper, packing tape, electrical tape, adhesive letters or numbers, spray paint, grease pencil, permanent marker, paint pens, shellac, nail polish, and circuit board transfer paper. The two primary mordants for etching metal are nitric acid and ferric chloride.

Etched designs can be as spontaneous or as precise as desired, and etched metal surfaces can be further enhanced with many techniques, including champlevé enameling, resin inlay, solder inlay, and patination. Etched sheet metal also makes an interesting texture source for roller printing.



Nitric Acid Mordant

Recipe:	
3 parts water to 1 part nitric acid	
Metals that can be etched in the same mordant bath:	
Brass	Bronze
Copper	Nickel
Metals requiring completely separate mordant baths:	
Mild Steel	Sterling Silver
Important: Always add acid to water. Always mix solution in a glass or ceramic container.	

Ferric Chloride Solution

Recipe:	
4 parts water to 1 part ferric chloride	
Metals that can be etched in the same mordant bath:	
Brass	Bronze
Copper	Nickel
Metal requiring completely separate mordant bath:	
Aluminum	
Important: Always add acid to water. Always mix solution in a glass or ceramic container.	

Etching Metal

This technique involves the use of toxic substances. Make sure to know and implement all safety precautions.

PROCESS

CLEAN the sheet metal to be etched with pumice or a green scrub pad until water sheets off its surface.

HOLD the clean metal only by its edges, making certain not to leave any fingerprints on the surface.

COVER the back surface of the sheet metal completely with a resist material.

Wide packing tape is the easiest option. Tape or glue on a piece of insulating foam that covers the whole surface area. This will keep the metal floating on the surface of the acid bath.

APPLY the desired resist to the front surface of the metal, keeping in mind that the area covered with resist will be the raised area on the etched sheet.

The application method can be additive or subtractive depending on the resist used.

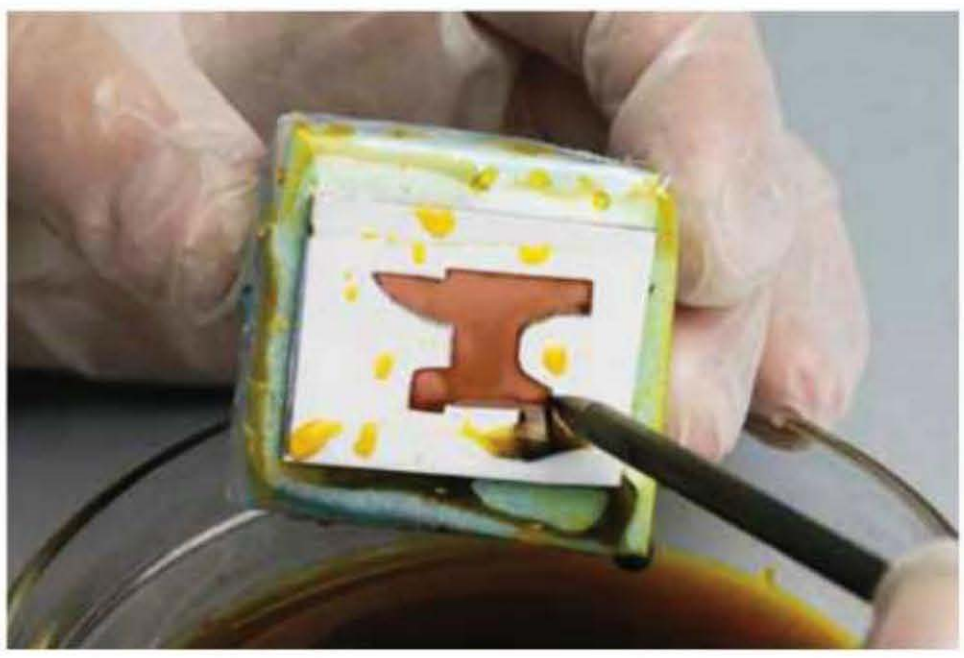
MIX the mordant solution in a glass or ceramic container following the manufacturer's instructions and safety precautions.

PLACE the metal to be etched in the bath.

WAIT about 20 minutes, and then check the metal to see the depth of the etching (see photo, left).

A fresh acid solution will etch faster than an old, used solution. When using a fresh solution, check your piece about every five minutes.

REMOVE the metal from the acid bath, sprinkle it with baking soda to neutralize the acid, and wash it under water with a scrub brush and more baking soda (see photo, right).



Repoussé

The ancient metal technique of repoussé produces a raised decorative surface. Although repoussé is most frequently applied to metal hollowware, it can be a beautiful addition to jewelry. Designs are created through the controlled stretching of sheet metal from both sides. A repoussé surface can be free-form or precise, and simple or extremely intricate. Repoussé is often used in conjunction with chasing.

Pitch

Pitch is used both for resistance and to give room for the metal to stretch. There are different kinds of pitch, which have different ways of hardening and holding onto metal. Some are oil-based, and some are made from tree resin. A good choice for a beginner is a resin-based pitch (photo, top), as it is more forgiving than the oil-based pitch (photo, bottom).

Creating Repoussé

Different sizes of dapping punches are useful for doming parts of a repoussé design. To create other, more specific shapes, you may need to make custom repoussé tools, although some are available through jewelry tool suppliers.

PROCESS

DESIGN a repoussé pattern, cut the metal to size, and use a scribe to transfer the design on the sheet metal.

A 16- to 18-gauge, 3-inch (7.6 cm) square sheet is a good size for beginners.

ANNEAL and dry the sheet metal thoroughly.

USE a soft torch flame to gently and carefully warm the pitch without burning it.

Constantly move the flame around the surface of the pitch.

It will take a while to heat the pitch to the desired temperature. The surface should be soft like caramel candy, not runny like molasses. You can also use a heat gun to warm pitch.

To keep the metal from sticking to the pitch, the surface can

continued on following page

Creating Repoussé

Continued from previous page

PROCESS

be coated with olive oil before heating. If this coating is applied too frequently, however, it can ruin the consistency of the pitch.

ALLOW the top of the pitch to slightly cool, and then secure the metal into the pitch with the scribed design facing up.

The pitch should rise a bit around the edge of the metal to secure it.

PUNCH the back side of the raised design into the metal.

REMOVE the metal from the pitch, turn it over, and re-secure the sheet.

WORK the front side of the raised design, using punches and repoussé tools to push down any areas that need flattening and to shape areas from the top of the sheet.

When the pitch starts to harden, remove the metal and re-heat the pitch.

The metal will have to be annealed throughout the process of punching and forming. Thoroughly clean the metal before each annealing to prevent fumes from burning pitch residue.

CONTINUE punching and forming the metal, first on one side, and then on the other.

USE a liner tool to further define the design at the end of the repoussé process.

OPTION: Texture the piece with chasing while the metal is still in the pitch.

REMOVE the finished piece from the pitch and sand it carefully so the details of the repoussé and chasing remain intact.

After a preliminary sanding, some additional chasing may be required.

POLISH or finish the metal as desired.

Granulation

In the ancient technique of granulation, small balls, or granules, of metal are fused onto a base sheet of metal to create an intricately patterned design. Although fine silver and high-karat gold are easiest to work with and show the beauty of this process best, sterling silver and other gold alloys can be used. There are several steps in the process of granulation, including making the granules, preparing the glue, positioning the design, preparing the eutectic solder, and finally, firing the granules with a torch or kiln.

Making a Small Amount of Granules

Three sizes of granules can be made from the same wire coil. After slightly pulling the coil apart, simply cut one, two, or three loops off at a time. Sort the snipped loops into corresponding piles.

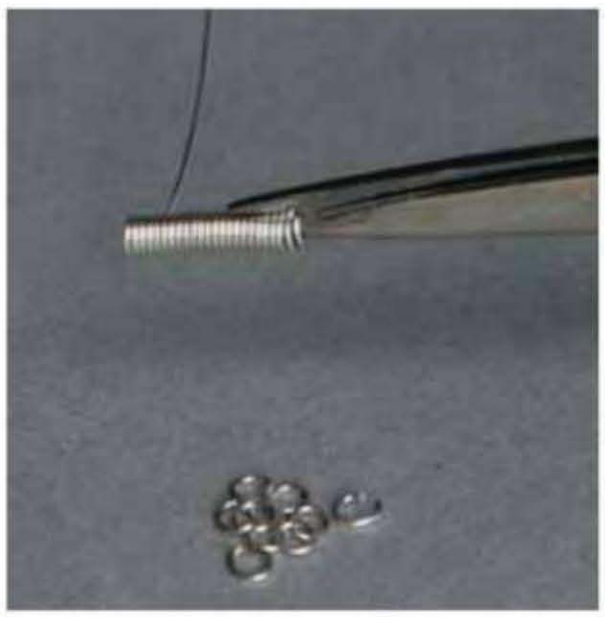
PROCESS

WRAP 28- to 30-gauge wire around a very small mandrel, such as 1-mm piano wire.

Each revolution around the mandrel equals one granule.

SLIDE the wire coil off the mandrel once the coil is the appropriate length for the number of granules needed.

PULL the coil apart gently with your fingers, making enough room for the tips of embroidery scissors to fit between each loop.



SNIP each loop apart from the next, essentially creating a pile of very tiny jump rings.

CARVE a groove around the edges of a compressed charcoal block with any small, sharp hand tool.

This is a very messy task that should be done outdoors.

The carved groove prevents the granules from rolling off the block when they are melted.

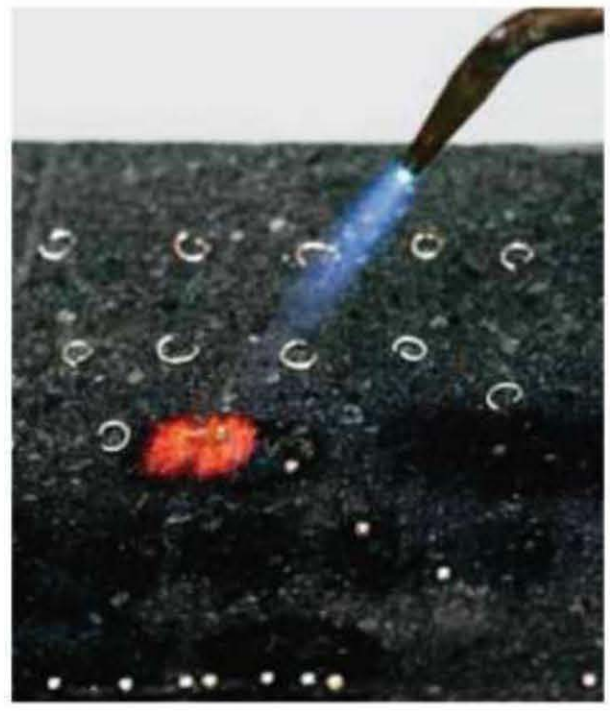
PLACE the cut wire loops on the charcoal block and space them approximately ⅛ inch (3 mm) apart.

This arrangement deters the granules from rolling into each other and become larger granules when melted.

LIGHT the torch and adjust the flame until it's bushy and medium sized.

A small, tight, hot flame puts out too much pressure and will make the granules roll around the charcoal block.

MELT the coils into granules gently with the torch.



LOAD the fully formed granules carefully into a bowl.

REPEAT this process to make different size granules if desired.

Making a Large Amount of Granules

PROCESS

WRAP 28- to 30-gauge wire around a very small mandrel, such as 1-mm piano wire.

Use a larger mandrel if larger granules are desired.

Each revolution around the mandrel equals one granule.

SLIDE the wire coil off the mandrel once the coil is the appropriate length for the number of granules needed.

PULL the coil apart gently with your fingers, making enough room for the tips of embroidery scissors to fit between each loop.

SNIP each loop apart from the next, essentially creating a pile of very tiny jump rings.

WET the wire loops with a few drops of water.

MIX the wet wire loops with powdered charcoal, so that a thin layer of charcoal forms around each loop.

The charcoal coating prevents the loops from sticking together when heated.

PLACE a layer of charcoal-coated loops in the crucible.

ADD approximately ¼ inch (6 mm) of powdered charcoal on top of the layer of loops.

REPEAT this process, alternating layers of charcoal-coated loops and powdered charcoal, until the crucible is full.

FIRE the crucible in a 1700°F (926.7°C) kiln until the crucible is red hot.

REMOVE the crucible from the kiln with tongs.

REMOVE a few of the metal pieces from the crucible with a spoon, and drop them into a bowl of water.

If the metal pieces have formed into round granules, you're finished. If not, place the crucible back in the kiln and refire it.

RINSE the fully formed granules with water, and dry them with a soft cloth.

Placing & Fusing the Granules

Prior to fusing the granules to the metal base, it's necessary to mix two solutions. The first, a hide glue and water mixture, adheres the granules in position. The second, a copper hydroxide solution, facilitates the fusion process. (Hide glue is sold in the woodworking section of hardware stores. Copper hydroxide is available from chemical suppliers).

Hide Glue Mixture

Recipe:
1 part hide glue
10 parts water

Copper Hydroxide Solution for Silver

Recipe:
1 heaping part copper hydroxide (Cu(OH)2)★
2 to 5 parts diluted hide glue (see recipe, left)
2 to 3 drops of high temperature liquid flux
★For silver, the copper hydroxide must be at least 65 to 85 percent pure, but compounds with a higher purity will also work.

Copper Hydroxide Solution for Gold

Recipe:
1 heaping part copper hydroxide (Cu(OH)2)★★
2 to 4 parts diluted hide glue (see recipe, left)
2 to 3 drops of high temperature liquid flux
★★For gold, the copper hydroxide must be at least 85 to 95 percent pure.

Important: Copper hydroxide is not water-soluble. During application, this solution must be constantly stirred to make sure the copper hydroxide is evenly distributed throughout the solution.

PROCESS

CLEAN the base piece of metal completely with pumice or kitchen cleanser, and hold the clean metal by its edges to avoid fingerprints.

OPTION 1

DIP a small paintbrush into the hide glue mixture, pick up the granules with the paintbrush, and place them on the base sheet.

OPTION 2

USE small tweezers to pick up and place the granules, dipping them in the hide glue mixture as you go (photo, left).

If too much liquid accumulates on the base sheet and the granules begin to move around, roll up the edge of a paper towel and gently place it near the liquid. The paper towel will wick up the liquid without disturbing the granule placement.

ADD the copper hydroxide solution to the granules that are in position with a small, natural-hair paintbrush, making sure the solution settles at the bottom of the granules (photo, right).

Do not allow the hide glue mixture to dry before adding the copper hydroxide solution to the granules. If the glue mixture dries, simply add more with the paintbrush.

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Placing & Fusing the Granules

Continued from previous page

PROCESS

WICK away any excess solution from the granules with a paper towel.

Very important—wherever there is copper hydroxide and glue together, the metal surface will melt when heated, causing unsightly blotches.

CLEAN up any mistakes with the paintbrush or a paper towel.

SET the piece aside and allow the glue mixture to dry completely.

If you have a kiln running, you can set the piece on top of it to dry faster.

Do not attempt to dry the piece with a torch. This will cause the water to spit and the granules to move or even fly off the piece.

PLACE the completely dry metal piece (with the granules in position) on a soldering block.

LIGHT a torch and adjust it to a soft but hot, bushy flame.

A very hot flame is too scorching, and a tight flame could disturb the granules.

HEAT the metal piece with the torch until the glue mixture turns brown (see photo).

CONTINUE heating the piece around the granulation design very slowly and gently—occasionally running the flame over the design—until the metal begins to appear silver or gold again. Do not rush this process.

WATCH the areas where copper hydroxide was added to glow red as the piece approaches granulating temperature, and then, once these areas turn orange, look for a silver or gold flash.

STROKE the torch flame over each granulated area gently as soon as the surface of the metal begins to shimmer and look watery.

This stroke is not a direct heating, but more of a pause right over the granules. This step fuses the granules to the base sheet, so it is very important. The granulation bonds, however, do not form instantly. The piece must be held at the granulating temperature for a few seconds. Do not overheat the piece, as the granules could melt into the base and lose their shape.

REMOVE the heat and let the piece air cool, but do not quench or pickle it.

CHECK the granules with tweezers.

If any granules are loose and did not fuse, repeat this process from the beginning. You can refire the piece two or three times without pickling.

PICKLE and rinse the piece once all the granules are fused to the base.

Finishing a Granulated Piece

After pickling, it's best to simply rub a granulated piece with a fine-bristle brass brush to shine it. Do not attempt to use any kind of polish on the piece except for rouge compound. Polishing with a coarser compound will diminish the roundness of the granules and the piece will appear dull and flat. If using rouge compound, don't hold the piece too firmly against the polishing wheel. Be gentle, let the wheel do the work, and constantly check the piece to make sure the granules are retaining their integrity.

Mixed Metal Techniques

Using multiple colors of metal in a single piece of jewelry can yield strikingly different results. The visual shift from tone to tone can be highly dramatic or surprisingly subdued. For ease of instruction, the metals used as samples in this chapter have a high color contrast, but you may want to experiment with more closely colored metals in your own designs.

Lamination

Lamination is a technique that adds color to jewelry through the appliqué of different metals. It requires some experimentation and flexibility.

PROCESS

SELECT a base sheet of metal that is thicker than you want your final sheet to be.

For example, if you want to end up with 22-gauge metal, begin with a 20-gauge sheet.

SAW out a shape from a second type of metal to appliqué to the base sheet.

SWEAT SOLDER the metal shape to the base sheet.

ADJUST the rollers of a rolling mill so they are slightly thinner than the total thickness of the base sheet and appliqué.

ROLL the sheet through the rolling mill several times, decreasing the space between the rollers each time until the appliqué is flush with the base sheet and annealing the sheet between rolling as needed.

The shape of the appliqué will become distorted. Use this to your advantage in your design.

Solder Inlay

Solder inlay involves creating a line drawing on a sheet of metal, sawing out the design, and then filling the negative space with solder. This technique produces a subtle yet beautiful design on a piece of jewelry. Alternately, sheet metal can be roller printed and the imprinted areas filled with solder to make a two-toned design.

PROCESS

DRAW or transfer a line drawing onto a small sheet of metal.

It's a good idea to begin this technique on a metal sheet that's no larger than 2 inches (5.1 cm) square. It's possible that a larger sheet of metal will warp from heat.

Begin the drawing at the edge of the metal sheet or from a 0.25-mm drilled hole on the interior of the sheet.

If the drawing starts at the edge of the metal, make sure the design doesn't cut the metal apart. If you're simply trying to place two pieces of metal next to each other, you won't be able to control the thickness of the solder line.

SAW out the line drawing with a 1/0, 2/0, or 3/0 size blade.

The smaller the blade you use, the thinner the line will be.

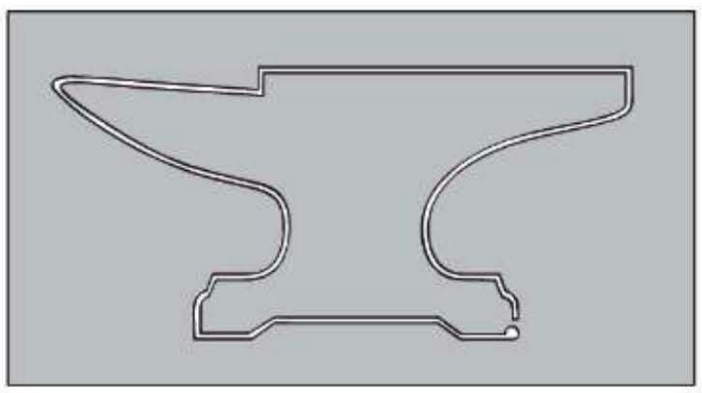
PLACE the sawn metal on a flat, honeycomb soldering block.

FLUX all the saw lines on the sheet.

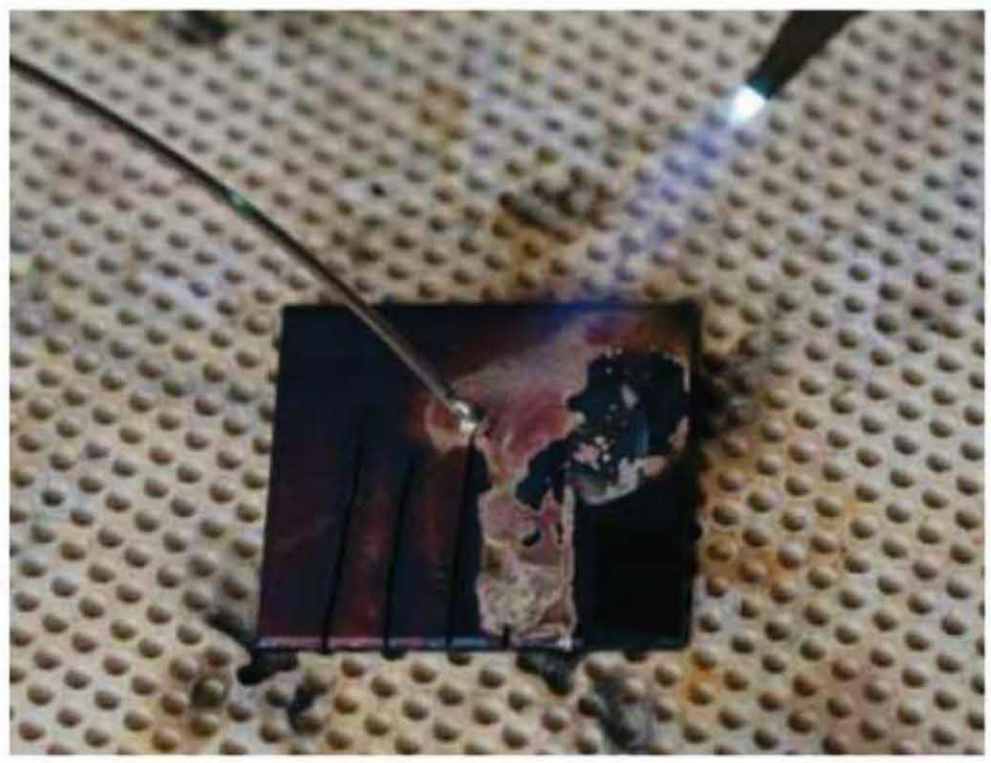
HEAT the metal with a torch and run solder down all the saw lines, making sure the solder completely fills the lines.

Stick soldering works best for solder inlay (see photo).

FINISH the piece by filing and sanding the solder inlay.



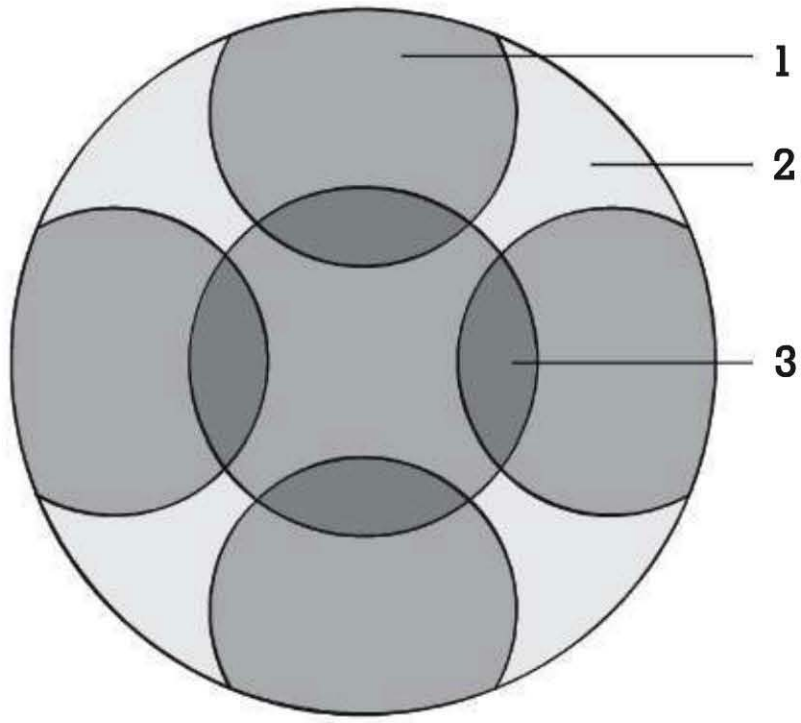
Do not saw the shape in its entirety or you will lose the solder inlay line.



Marriage of Metal (Married Metals)

The marriage-of-metal technique produces a multicolored metal design. It's not a surface treatment, but rather a puzzle-like method of assembling metals of different colors. Marriage of metal differs from inlay in that the different metals are not adhered to a base form. They are solid sheets joined together with solder. Brass, copper, nickel, silver, gold, and shakudo are all excellent choices for marriage-of-metal jewelry.

One marriage-of-metal technique, the puzzle method, uses a design with positive and negative spaces and two or more colors of metal. One metal is used to fill in the negative space on another metal.



Sample marriage-of-metal design using three metals (1, 2, 3)

The second technique, the pattern method, uses strips or shapes of different metals. The pieces are arranged side by side and soldered together to create a pattern.

Puzzle Method for Marriage of Metal

A finished marriage-of-metal sheet can be set in a bezel, soldered onto other metalwork, or used to create hollow forms. Be sure to use easy solder for all subsequent soldering operations and keep the heat of the torch away from the joints on the marriage-of-metal sheet.

PROCESS

DETERMINE which color of sheet metal to use as the base and which to use as the insert.

Beginners should consider using a base sheet that is no larger than 2 inches (5.1 cm) square. A larger sheet can warp and move when heated.

DRAW or transfer the insert design onto the base sheet.

DRILL a hole through the base sheet near an inner edge of the insert design.

CUT out the design with a jeweler's saw to form the negative space.

FILE or sand all cut edges until they are smooth and even.

PLACE the base sheet on top of the insert sheet, and use a scribe to trace the shape of the negative space onto the insert metal.

CUT out the traced shape with a jeweler's saw, following the outside of the scribed lines.

It is better for the shape to be slightly large than too small.

CHECK that the insert fits into the negative space of the base sheet perfectly without gaps.

If the insert is too large, use a needle file or sandpaper to slowly remove metal on the edges where the shape does not fit. If the shape is too small, start over on a new piece of insert metal.

PLACE the metal pieces together on a flat soldering block, and apply flux where the two metals meet.

SOLDER the metals together with hard solder, letting the solder flow by means of capillary action.

Add solder if the initial amount doesn't flow around the entire seam.

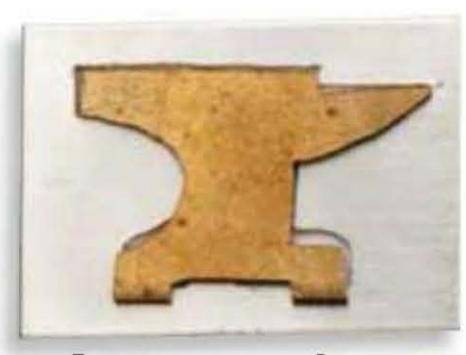
It is okay for there to be lots of solder and for the piece to look messy (see photo, above).

PICKLE and rinse the piece.

REMOVE any excess solder from the marriage-of-metal piece with a file.

This may be easier to accomplish if you slightly bend or dome the metal first.

The marriage-of-metal piece doesn't have to be completely clean and finished before it is used in jewelry. To maintain a good thickness on the marriage-of-metal sheet, it can be sanded and finished after all other soldering operations are complete.



Insert is too large

Insert is too small

Insert is the correct size

Pattern Method for Marriage of Metal

Making marriage-of-metal patterns can be a very simple or a very complex process. The finished, patterned sheet can be used in any type of jewelry.

PROCESS

SAW out all of the metal pieces that will be soldered together into a pattern.

FILE or sand the cut edges to make all adjacent pieces perfectly flush.

ARRANGE the metal pieces on a flat, honeycomb soldering block to create the desired design, and flux all seams to be soldered.

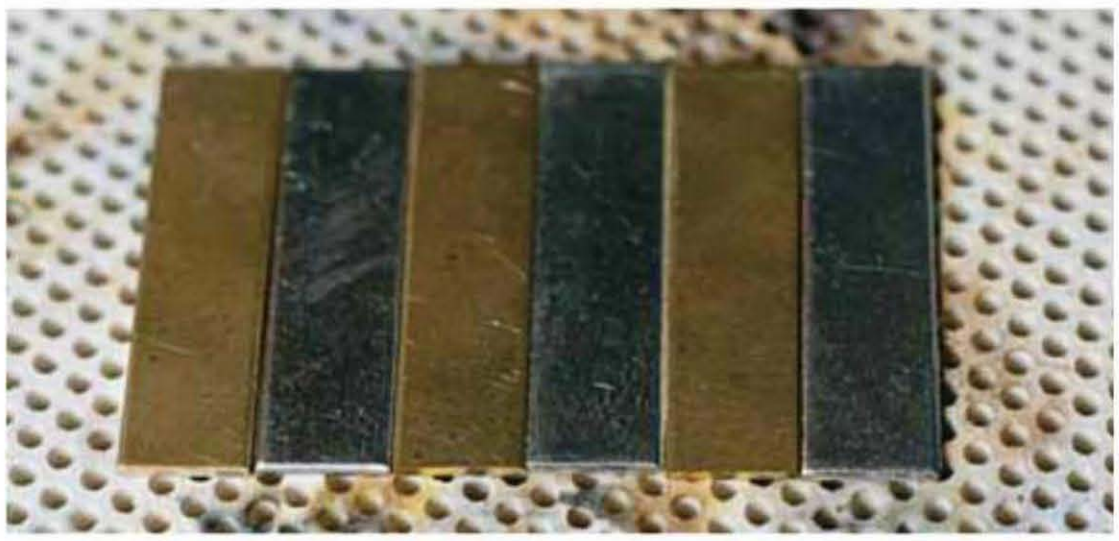
JOIN the metals together with hard stick solder, and then pickle and rinse the soldered sheet.

At this point, if desired, use the jeweler's saw to cut the patterned sheet apart again, acting as if the metal is simply a new sheet. Using this method, you can achieve intricate designs without having to arrange small pieces (see drawings below).

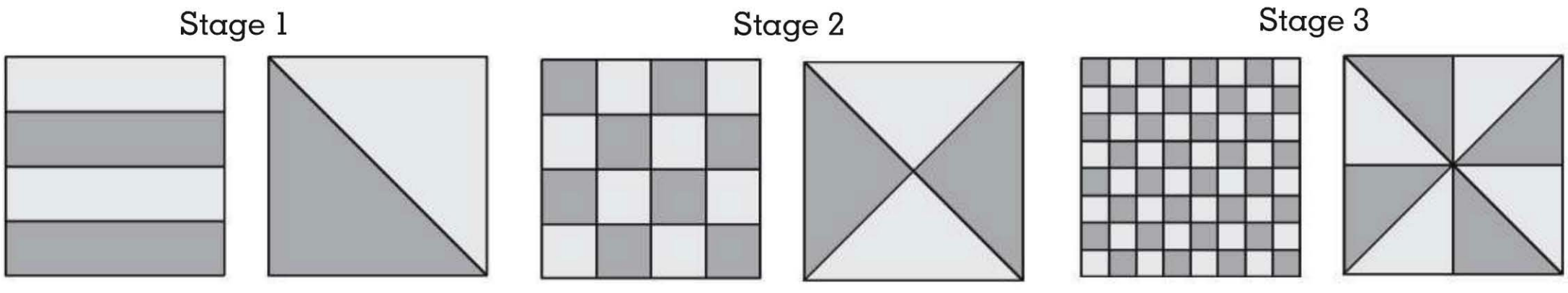
FILE the excess solder off the surface until all joints are clean.

SAND the metal with 220-grit paper, and then finish with 400-grit paper.

A marriage-of-metal piece is most impressive with a matte finish.



To form more intricate patterns, the initial sheet can be cut apart, rearranged, and resoldered. The illustrations below show a strip pattern made into a checkerboard and triangle pattern made more complex.



Kum Boo

In this traditional Korean technique, also known as keum bu, thin gold foil is bonded to another metal, most often sterling or fine silver sheet. The foil can be applied before and after the metal is formed into a jewelry piece. Most jewelers apply kum boo foil that is 22-karat gold and 0.004 mm thick. (This is not the same foil that is used for enameling.)

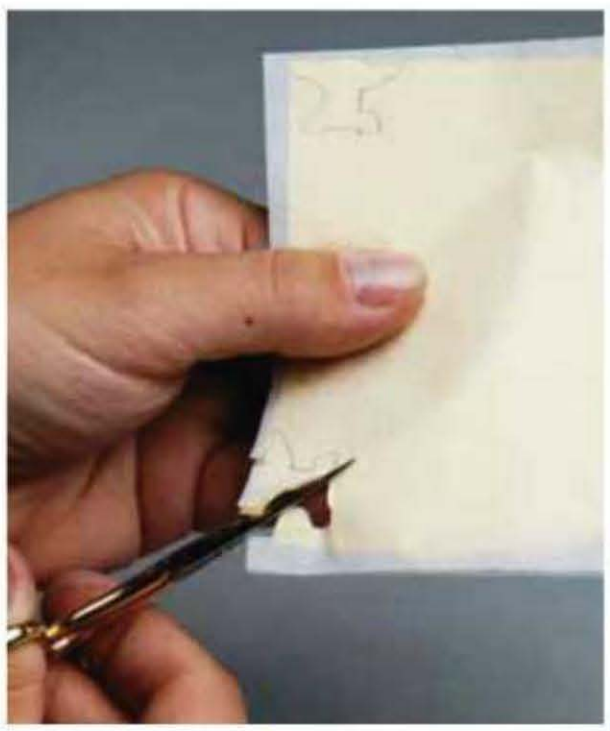
Applying Kum Boo

Kum boo utilizes a joining method known as pressure welding. First, the two metals are heated to a temperature where no oxygen is present between them. Next, the pressure of a burnisher is applied to the foil. Finally, the two metals are permanently bonded in a low-temperature, thin-molecular weld. In this process, the low heat of a hot plate set at 650°F (343.3°C) is used to activate the bond.

PROCESS

DESIGN the shape of the gold foil to be added to the silver.

USE embroidery scissors to cut the foil into the desired shape, and place the cut foil in a small dish next to your work area.



Before cutting the foil, sandwich it between two pieces of paper that are taped together. This allows you to cut the foil shape more easily without it floating away or becoming misshapen.

You can use hole punches to cut your foil. These are available in many different shapes.

TURN on the hot plate and adjust its setting to a medium-high temperature.

Experiment to see exactly how hot the plate gets at certain settings, and record this information for future use.

PLACE a 1-mm-thick steel plate onto the hot plate.

The steel plate helps the heat spread evenly throughout the base form and prevents small pieces of metal from falling through the hot plate burners.

FOR A STERLING SILVER BASE:
RAISE the fine silver to the surface through depletion gilding.

RUB the metal with a brass brush.

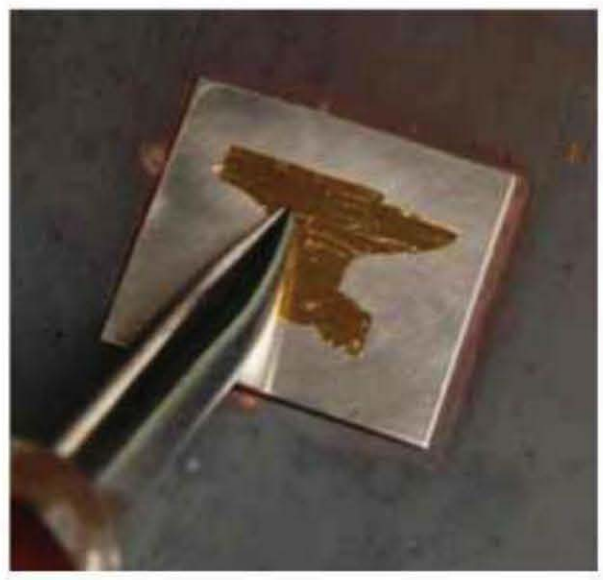
CLEAN the metal completely.

FOR A FINE SILVER FORM:
CLEAN the metal form completely.

PLACE the clean metal on the preheated steel plate and let it warm to the hot-plate temperature.

PICK UP a cut foil shape with tweezers or with a wet paintbrush (whichever works best for you) and position the foil on the metal.

PRESS the foil into place with a polished burnisher.



If the metal is hot enough, the foil will easily stick to it.

If the metal is not hot enough, the foil won't stick. In this case, either increase the temperature of the hot plate or wait until the metal gets hotter.

CONTINUE burnishing the foil very lightly and quickly, rubbing with smooth strokes.

POSITION and burnish any additional gold foil pieces to complete the kum boo design.

Re-burnish any foil that bubbles up. If there is a large bubble in the foil, poke it with a pin to let the air out, and then re-burnish it.

Finishing Kum Boo

A matte surface is a desirable finish for kum boo. A black patina is also an attractive choice because the patina will color the silver but not the gold foil. A highly polished surface is less favorable because it will mask the color difference between the gold and silver. If you intend to use a polishing machine, however, do so with great care, as the polishing compound will quickly remove the gold foil.

Tips

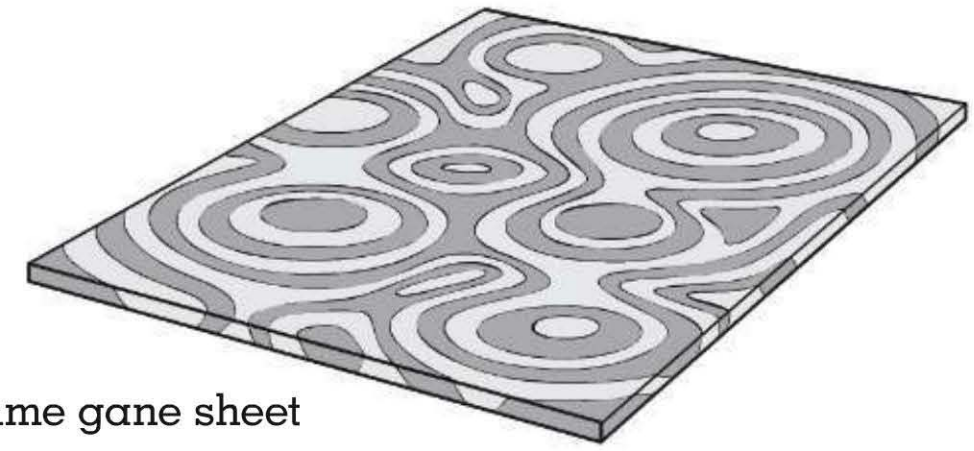
If the metal form gets too hot, the gold foil can diffuse into the metal, dulling the color of the foil and weakening the kum-boo effect.

If this happens, either:

- Lower the temperature of the hot plate.
- Remove the metal form from the hot plate to let it cool for a moment, and then add more foil to the affected area.
- Add a drop of water to the overheated area to cool it, but make sure the water does not come between the gold foil and the base form.

Mokume Gane

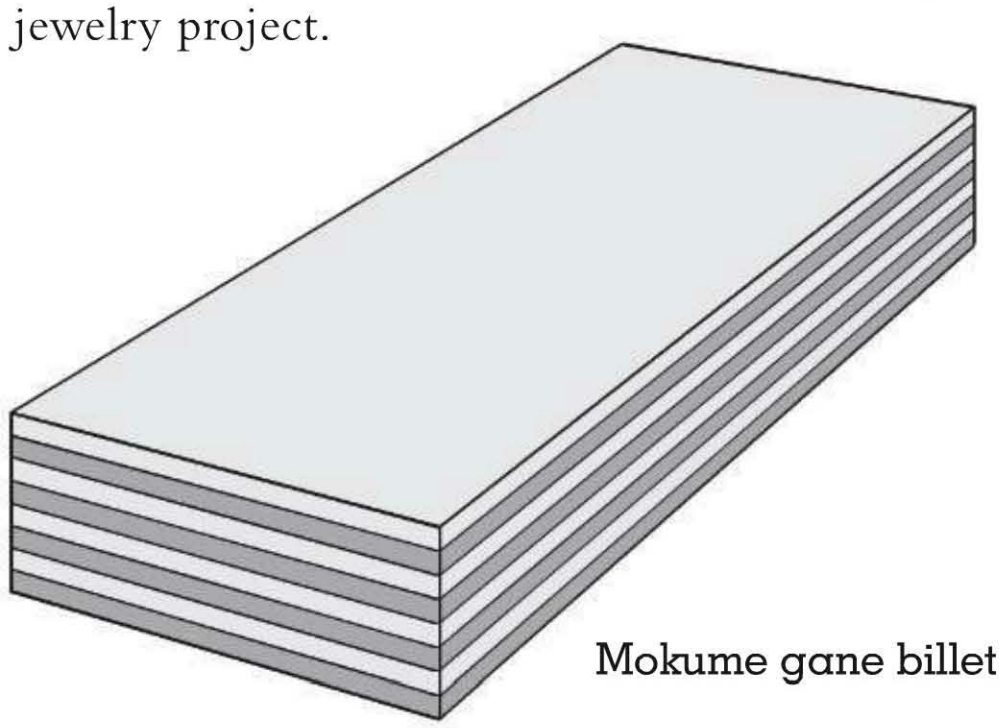
Mokume gane, often abbreviated as mokume, is an ancient Japanese technique that gives metal a wood grain appearance. Different colors of metal are bonded together and the layers are manipulated to produce a pattern.



Mokume gane sheet

A mokume billet is the stack of bonded metals. The individual layers are not soldered, but bonded together through diffusion welding. In diffusion welding, the metal layers are heated in a kiln until the surface molecules of each layer bond without solder or any other intermediary metal binder.

Producing a mokume billet is extremely technical and requires a sizeable investment in tools and materials. Fortunately, mokume laminate or sheet stock can be purchased from metal suppliers. This laminate differs from a billet in that it is already made of super-thin layers of metal. You don't have to thin out a billet by forging in order to have material ready to work. The following pages offer two methods for patterning mokume without producing the billet. The decorative metal produced can be used in any jewelry project.



Mokume gane billet

Punch Patterning Mokume Sheet Stock

This technique—punching the mokume to create a pattern—is similar to chasing. Use liner tools to chase intricate designs or simply make a series of indentions. Each tool will make a different pattern on the mokume.

Note:

18-gauge mokume sheet stock is recommended for this process. It should arrive annealed, but check with the metal supplier prior to ordering. If only 14-gauge stock is available, use a rolling mill to thin it to 18 or even 20 gauge before patterning. (The metal will probably need to be annealed halfway through the rolling process.)

PROCESS

CHOOSE one side of the 18- or 20-gauge mokume sheet to be the top surface of the piece.

WARM the pitch with a torch.

HEAT the mokume sheet to a low temperature, and place it in the pitch with the back surface of the metal facing up.

The pitch should melt and encase the edges of the sheet to hold it firmly in place.

PUNCH the mokume sheet with chasing or repoussé tools to create a pattern.

Do not punch the sheet more than halfway through its thickness. A punch that is too deep may cause a hole in the sheet when the top of the raised surface is sanded. Control the depth of the punch by the force of the hammer blow. It's best to make lighter hammer strokes. Subsequent punch marks can always make the pattern deeper.

REMOVE the punched sheet from the pitch, and clean any residual pitch off the metal.

If punching has curved or deformed the sheet, place it on a steel block and use a mallet to hammer it flat.

GRIND or file off the raised surfaces on the top surface of the punched metal.

Once flattened, each punch mark should expose several layers of metal, producing an intricate pattern.

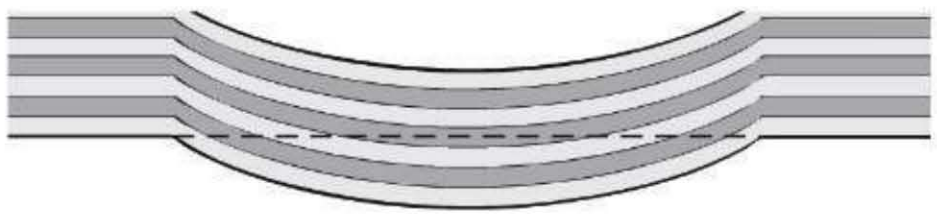
FINISH the punch-patterned mokume sheet.

OPTION 1

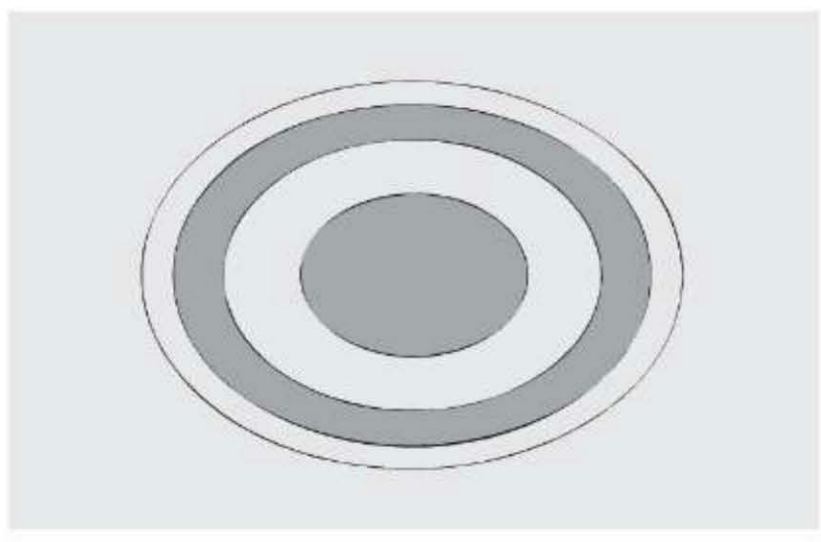
To roll the sheet thinner, fill all indentions on the back of the sheet with solder. This prevents any of the thinner areas of the sheet from cracking or splitting. Anneal the sheet. Roll it through the rolling mill until the desired thickness is achieved. Note: Rolling the metal thinner will alter the mokume pattern.

OPTION 2

Sweat solder a solid sheet of metal to the back of the punch-patterned mokume to make a laminate. (This option is especially helpful when the back of the metal will show in the finished piece.)



Side view of punched sheet



Top view after removing raised surface

New Tool

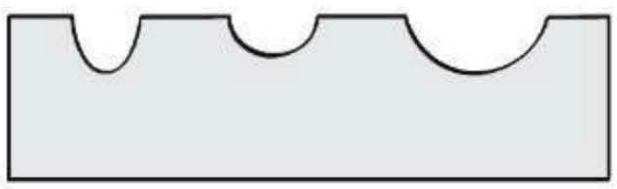
A chisel is a hand tool with a wedged, cutting edge at one end that gouges metal. The opposite, flat end is struck with a hammer.

Gouge Patterning Mokume Sheet Stock

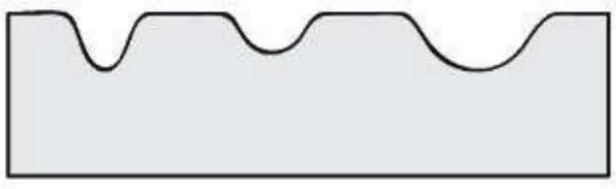
Using thick mokume sheet stock—⅛ or ¼ inch (3 or 6 mm)—allows for more intricate gouge patterns.

PROCESS

USE grinding burrs or a chisel to gouge patterns in the mokume sheet stock that are approximately one third of the way through the thickness of the metal.



ROUND off the edges of each gouge with 220-grit sandpaper, a grinding attachment, or a burr, to prevent the edges from turning over and creating air pockets when the sheet is forged.



PLACE the gouged sheet on an anvil or large steel block.

USE a forging hammer to flatten the sheet, hammering the higher surfaces first, concentrating the blows on the middle of the sheet, and annealing the sheet several times during the process.

It's easier to move the metal at the edges of the sheet. The middle of the sheet must be sufficiently hammered to achieve a good and even result.

RE-GOUGE the flattened sheet one third of the way through its thickness, round the edges of each gouge, and flatten the sheet with a forging hammer.

ANNEAL the gouge-patterned sheet, and make sure its surface is almost perfectly flat except for hammer marks.

ROLL the metal through the rolling mill until it reaches the desired thickness.

Making Twisted Wire Mokume

Use mokume sheet stock that is at least ¼ inch (6 mm) thick.

PROCESS

SAW a length of mokume sheet stock that is approximately 5 mm wide, cutting the sheet straight and even.

ROLL the thin metal through a square groove on a rolling mill to make an even piece of square wire.

SECURE one end of the square wire in a vise, hold the opposite end of the wire in a pair of pliers, and twist the metal.

Twist the wire as tightly or loosely as desired. With practice, you'll know what type of twist makes what type of mokume pattern.

OPEN the rollers on the mill far apart so the edges of the twisted wire won't turn over and create air pockets.

ROLL the twisted wire slowly through a square groove on the rolling mill.

CONTINUE rolling the wire through the mill until it's completely square, and then anneal the wire.

ROLL the wire through the flat area of the rolling mill to make the metal more rectangular.

CUT the rolled metal in half with a jeweler's saw to reveal the mokume pattern on the inside and use this decorative surface in any jewelry project.

Finishing Mokume

The options for finishing mokume gane depend on what metals are in the piece. A dark patina may only alter the appearance of one of the metals, producing an attractive visual contrast. Mokume can be etched, making some layers higher than others and giving the metal a wood grain texture. Mokume looks best with a matte finish. A shiny, high polish masks the different metal colors. For a nice clean look, scrub mokume with a green scrub pad or steel wool.

Findings & Mechanisms

Findings are the components needed to make a piece of jewelry wearable—the clasp on a bracelet, the bail on a pendant, the wire on a earring, or the pin on a brooch. Mechanisms, such as hinges, allow forms to move. These elements can all be hand-made and customized to match and improve a design, but most importantly, they must perform their function well.

Jump Rings

One of the most common and useful jewelry findings is the jump ring. A jump ring can be made from any shape or size wire, and be used as a connector or as a complete ring. It is very important to know how to properly make and open and close a jump ring.

PROCESS

WRAP the wire around a mandrel, making sure each revolution wraps neatly around the mandrel and touches the previous revolution.

The diameter of the mandrel equals the inside diameter of the jump ring, minus the width of the saw blade.

The number of wire revolutions depends on the number of rings you wish to make. Make a long coil if you need to make a lot of jump rings.

SLIDE the wire coil off the mandrel.

A long coil of heavy gauge wire is easy to saw apart. If you're using a smaller gauge wire and are making a lot of small jump rings, snipping the coil into 1-inch (2.5 cm) sections will make the individual rings easier to cut apart.

REST the coil column vertically your bench pin and hold it firmly in your fingers.

POSITION the jeweler's saw at the top of the coil with the blade at a slight angle to the wire.

CUT the jump rings apart with the saw, sawing at a slight angle down the length of the coil (see photo).

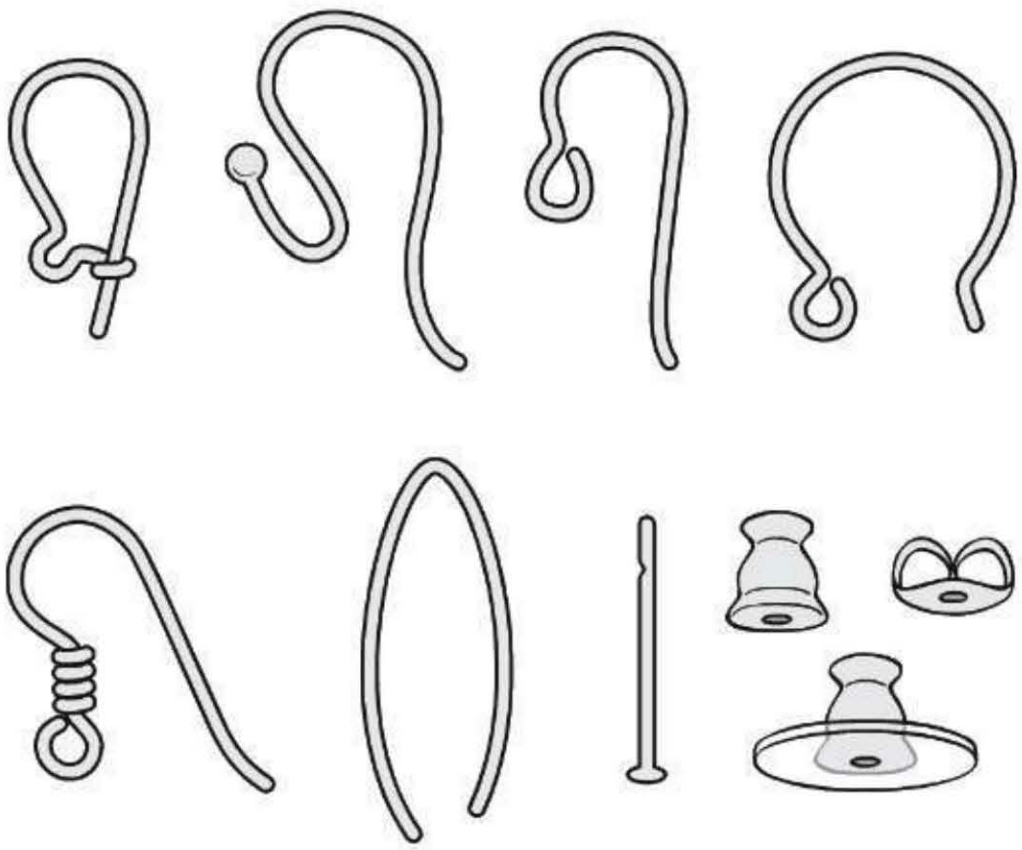
Sawing will be easier if you hold the coil in your fingers tightly.

Tips

- To open and close a jump ring, hold each side of the cut with a pair of pliers. Open and close the ring by moving the ends side to side on the same plane rather than in and out like a lobster claw.
- When using jump rings as connectors, it's most professional to solder the rings closed after the parts have been connected. Jump rings made of thinner gauge wire may stretch under tension and come apart unless they are soldered closed.
- When using thicker gauge wire, sand the rings at the solder point for a smooth looking ring.

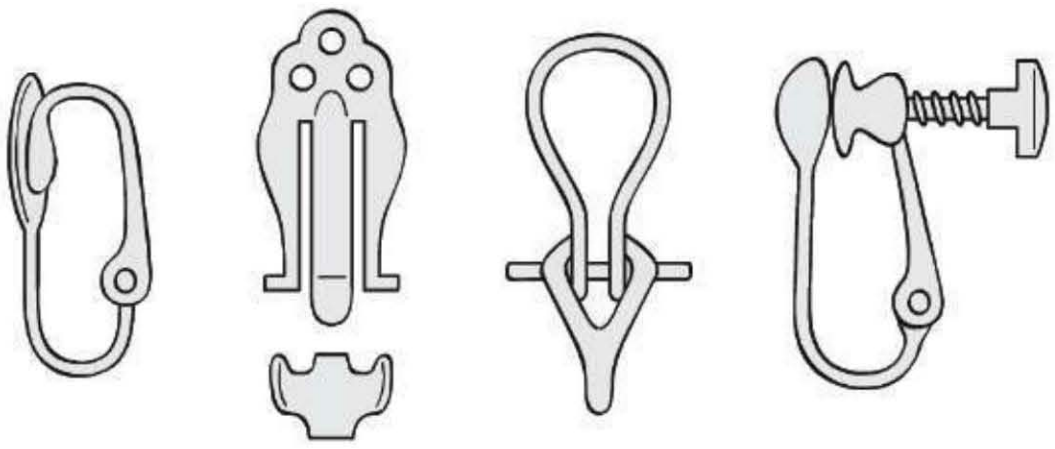
Ear Wires

An ear wire feeds through an ear piercing, enabling an earring to be worn. A nut secures an ear wire to the ear. French ear wires usually hang through the lobe without a nut, while posts require a nut to hold the earring in place. Ear wires are typically 19 or 20 gauge. Posts are generally ⅜ inch (9.5 mm) long, but can vary depending on your need and preference. The length of French wires can vary considerably.



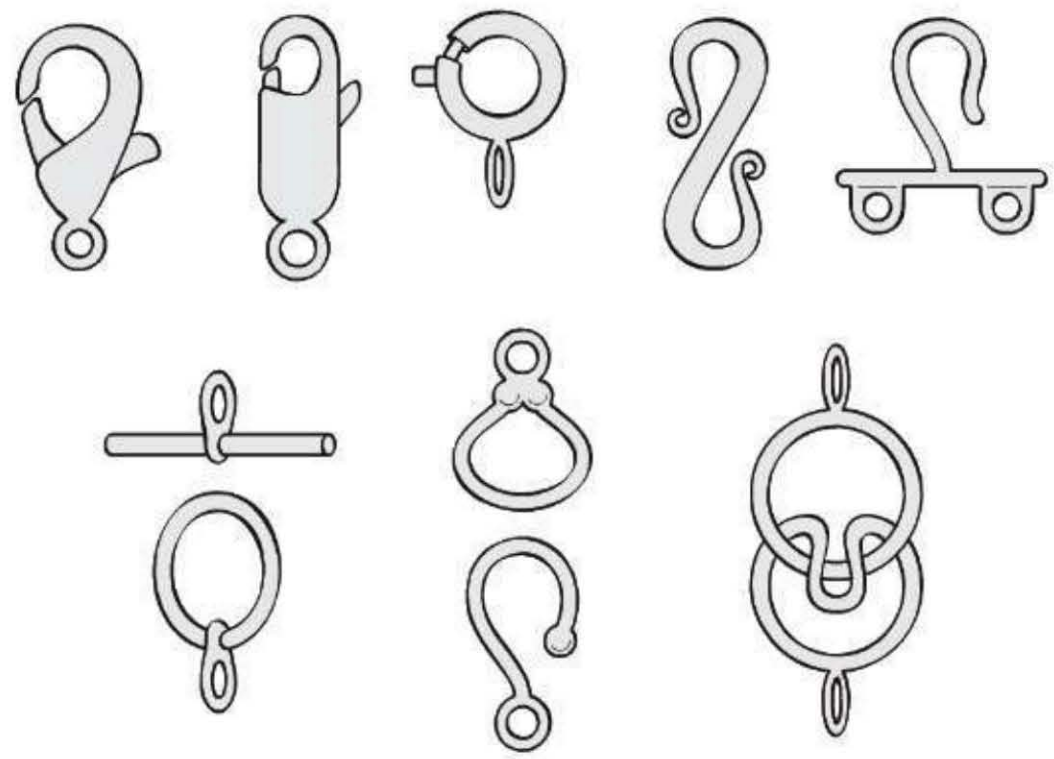
Findings for Non-Pierced Ears

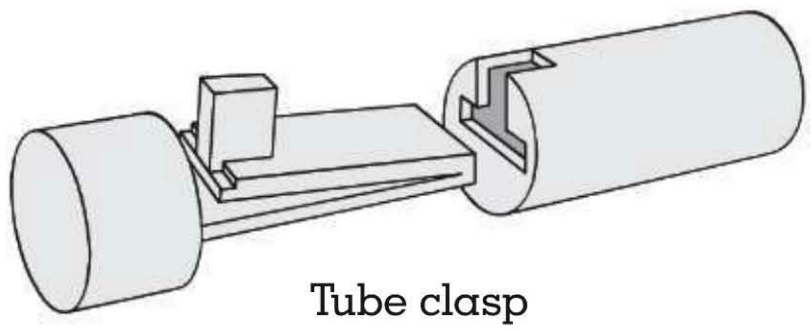
There are several types of earring findings, such as clips or screws, for ears that are not pierced. Selecting the type to use is based on the style of earring as well as personal preference. Experiment to find the variety you like.



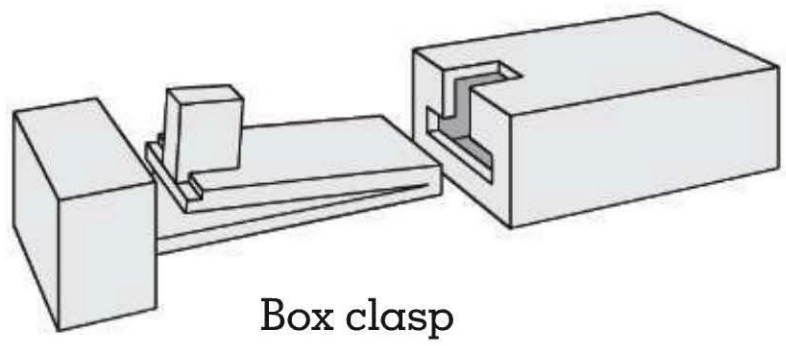
Clasps

Clasps are used to secure bracelets and necklaces onto the body. They can accentuate your design in style, but most importantly, they should be easy to use and completely secure. Since people tend to reject jewelry that is too difficult to operate, it's better to create a simple clasp than one that is too complicated. You can buy readymade clasps, alter existing clasps, or construct your own. Be creative.





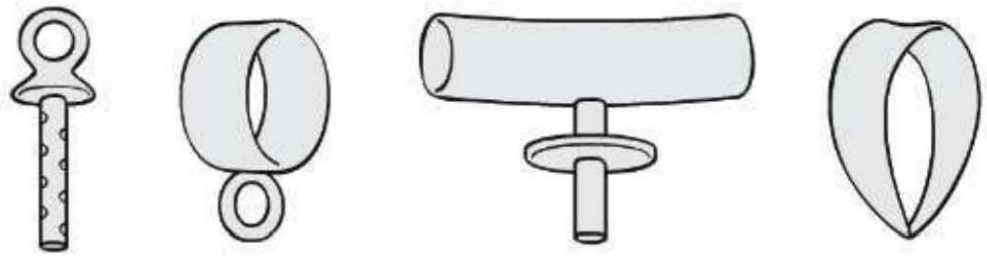
Tube clasp



Box clasp

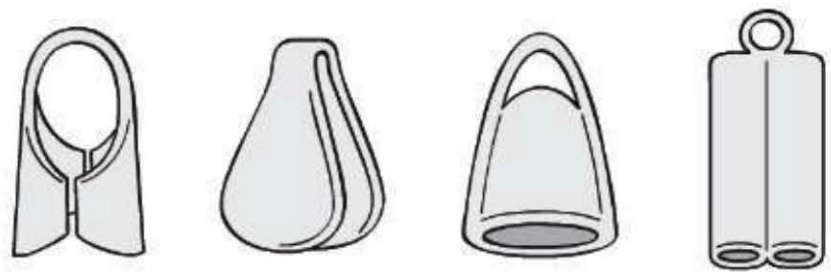
Necklace Bails

A bail attaches a pendant to a chain. Bails can be visible or hidden and made in countless shapes and sizes. You can design a bail to compliment a pendant, or use a simple jump ring. Whatever you choose, make sure it enhances rather than detracts from your jewelry design. A bail can be placed on top of the pendant, through a drill hole near the top, or on the back of a pendant. The bail must be placed above the center of the pendant so it won't flop over when worn.



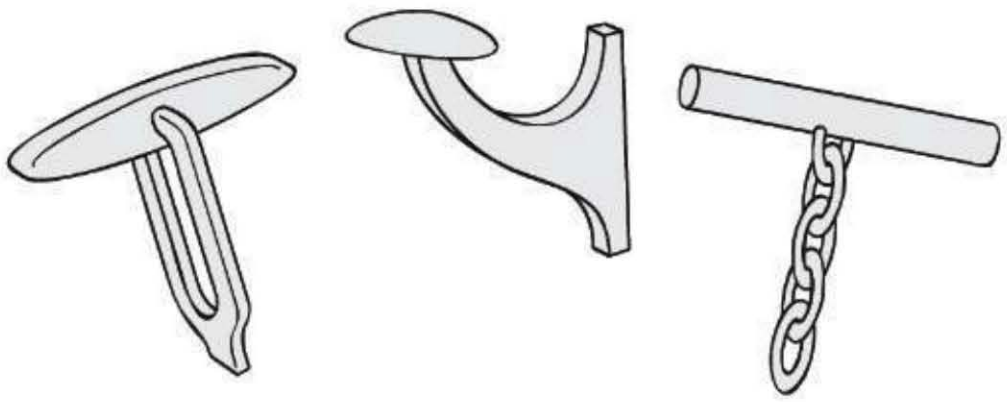
Chain Caps

Chain caps are used to finish chain ends and to attach the chain to the clasp and catch. You can make your own with tubing and a jump ring, or buy pre-made ones.



Cuff Links

Cuff links are used to close a French cuff on either men's or women's shirts. Men's shirts have two folds of cloth and require a larger space of approximately ¾ inch (1.9 cm). Women's shirts have only one fold and therefore require a smaller space of about ½ inch (1.3 cm). Cuff links can have designs on one or both sides.



Belt Buckles

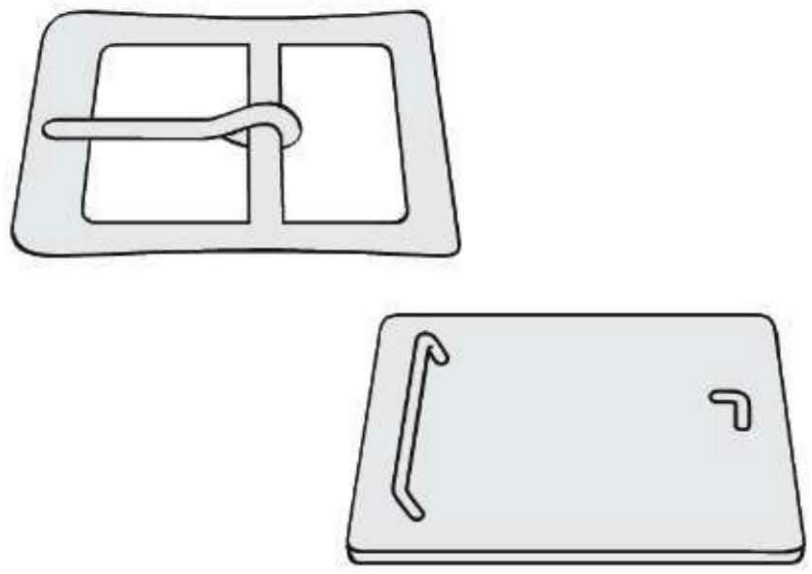
You can purchase and decorate belt buckle blanks and findings, or you can fabricate the entire piece from scratch. When constructing a belt buckle, here are some guidelines to follow:

- The belt bracket goes on the left side and the catch goes on the right.

- The bracket should be about ¼ inch (6 mm) tall in order to accommodate two layers of leather.

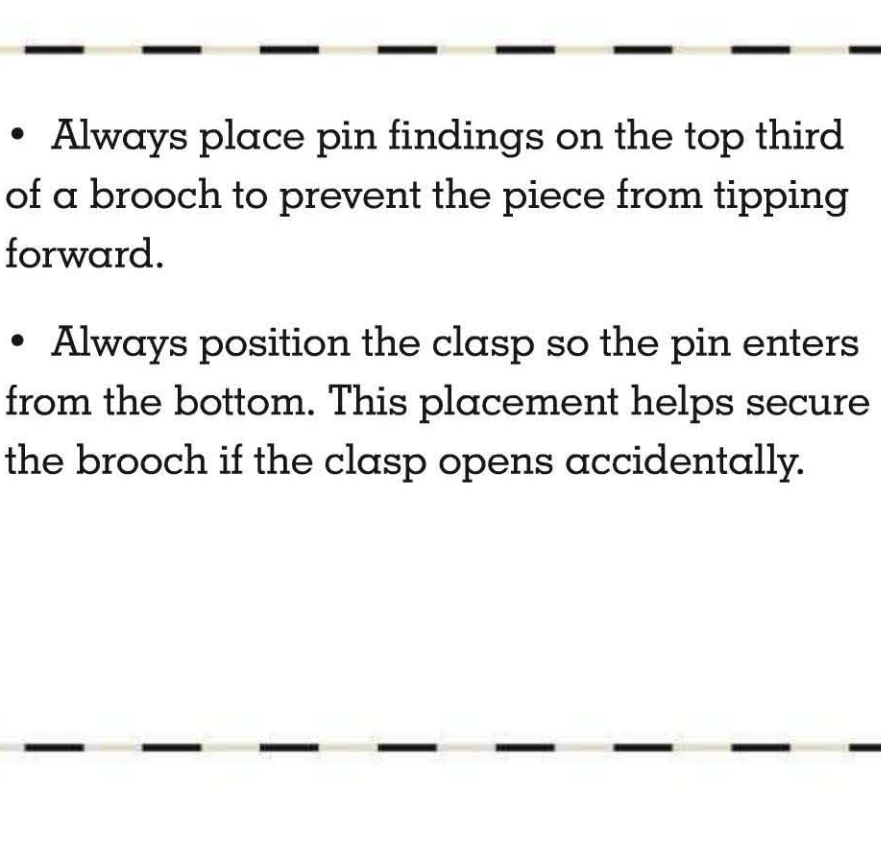
- The catch should be about ⅜ inch (9.5 mm) tall with a slight curve that faces to the left.

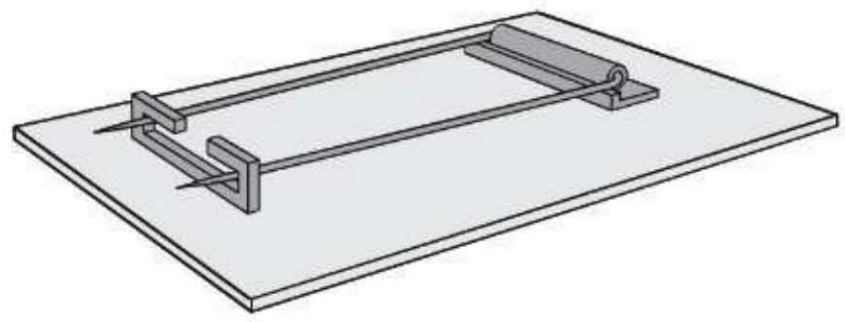
- The sheet metal must be thick enough to stand up to stress of wear (at least 16 gauge if working with nonferrous metals).

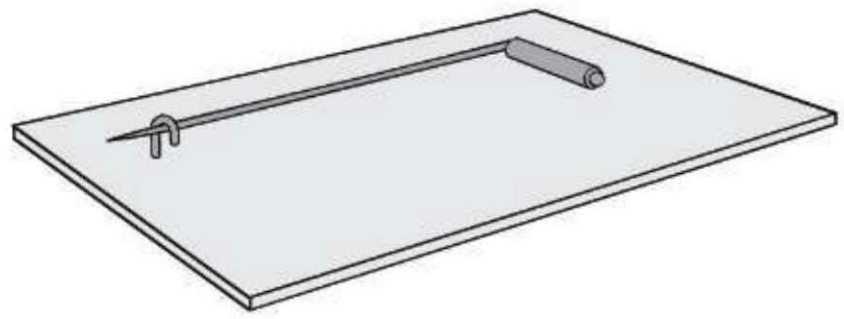


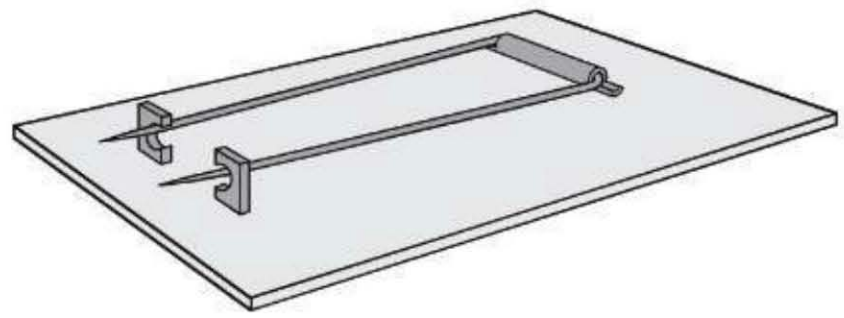
Pin Catches & Joints & Pin Stems

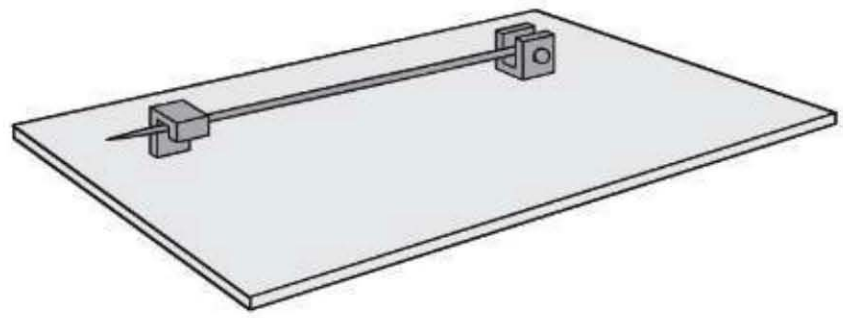
Although a huge variety of commercial pin catches, joints, and pin stems are available to purchase, when making quality handmade jewelry, it's important to make a quality catch and joint by hand. This finding can make your work distinctive and should not be overlooked. Here are some sample designs for constructing your own findings.





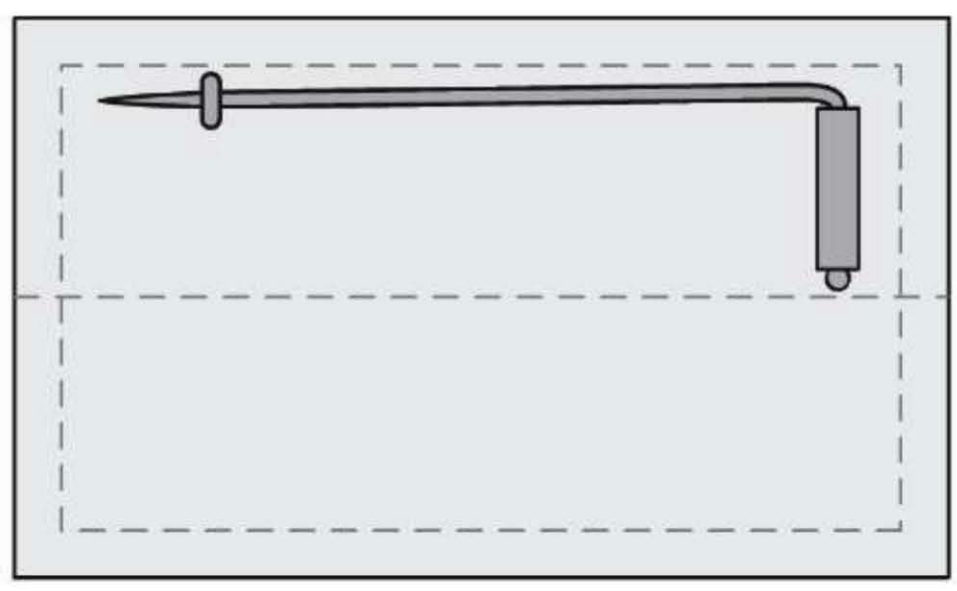






Tips

- Always place pin findings on the top third of a brooch to prevent the piece from tipping forward.
- Always position the clasp so the pin enters from the bottom. This placement helps secure the brooch if the clasp opens accidentally.



Hinges

Hinges are an outstanding way to connect links in a bracelet or a necklace, and they can be used to provide movement in a pair of earrings or on a brooch.

Hinges

Knowing how to make a good basic hinge is very useful for jewelers. The instructions that follow are for constructing the most basic hinge. There are many types of hinges you can make, such as a hidden hinge, a spring hinge, or a flush hinge.

PROCESS

DETERMINE what size tubing to use for the hinge.

A good practice size for beginners is tubing with a 2.5-mm outside diameter.

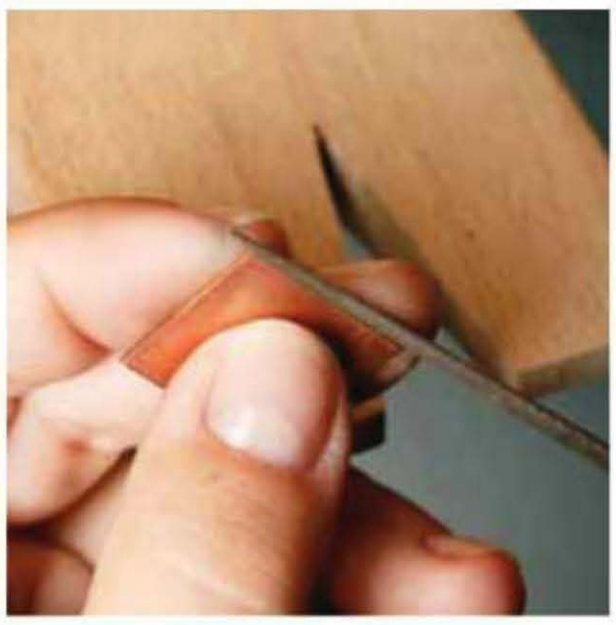
SELECT a wire with a diameter that perfectly fits inside the tubing.

USE a jeweler's saw to cut two 1-inch (2.5 cm) squares of 18-gauge (or thicker) sheet metal.

The small size of the metal squares is perfect for making a practice hinge.

FILE all cut edges of the metal squares smooth and even at a 90° angle.

USE a round file to slowly file an even groove that is a half-circle deep into one side of each metal square.



This groove should form a nice seat for the tubing.

For easier, more secure filing, secure the sheet metal in a ring clamp.

DECIDE if you want to make a three- or five-knuckle hinge and determine the length of each knuckle.

A hinge should always have an uneven number of knuckles.

To ensure the hinge has the proper strength, the middle knuckle should be of equal length to the outer knuckles, if not a little longer.

Knuckle length can be used to enhance the design of a jewelry piece. One recommendation is to make the middle knuckle a little longer than the outer knuckles, and on a five-knuckle hinge, make the end knuckles the shortest ones.

Knuckles can also be decorated by means such as filing, sawing, or drilling, to add interest to your piece (see page 109).

CUT the tubing for the knuckles with the jeweler's saw, according to the previously determined lengths.

FILE the cut tubing edges with care at a 90° angle so they are perfectly flat.

Accurate sawing and filing is very important for making a good, tight hinge.

SELECT a drill bit or other steel rod that fits perfectly inside the tubing.

FEED each piece of tubing (each knuckle) onto the drill bit or steel rod in order, placing them close together.

POSITION the two 1-inch (2.5 cm) squares of filed sheet metal on the soldering block.

PLACE the cut-tubing hinge (still on the drill bit or steel piece) between the squares of sheet metal, and make sure the tubing touches both sides of the filed groove.

USE a small flux brush to gently apply one small drop of flux in the middle of each knuckle, alternating sides of the tubing.

Do not coat the entire hinge with flux.

CUT very small snippets of hard solder.

continued on following page

Hinges

PROCESS

continued from previous page

It's important not to use excessive amounts of solder on a hinge.

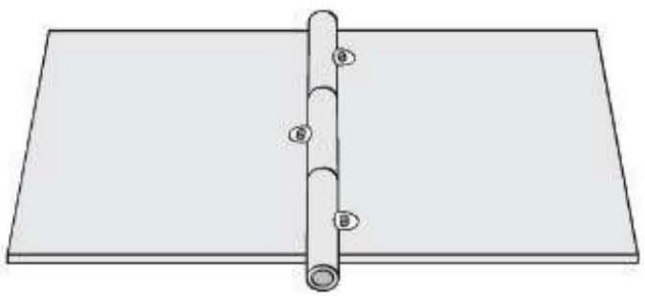
LIGHT the torch, adjust the gas to form a gentle flame, and begin heating the hinge.

USE a solder pick to gently place one snippet of hard solder at each fluxed location (in the center of each knuckle) as soon as the heated flux stops bubbling.

HEAT each knuckle slowly in succession until the solder becomes hot enough to tack the tubing to the sheet metal.

Be prepared to quickly move your torch away from the knuckle so it does not get too hot.

Tack soldering the knuckles at this stage is critical to making a good hinge. Do not let the solder flow all the way down the joint.



TURN off the torch once each knuckle is securely tacked to the sheet metal, and let the piece air cool.

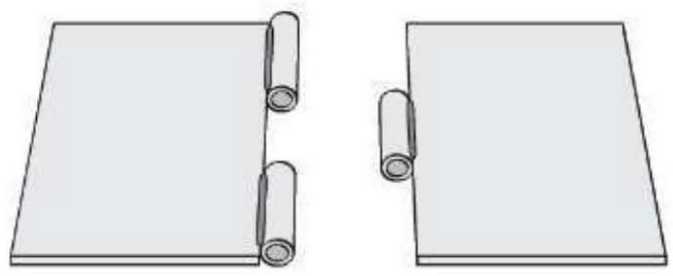
IMPORTANT Do not put the soldered piece in the pickle. The drill bit or steel rod inside the tubing will contaminate the pickle.

REMOVE the drill bit or steel rod from the hinge, and separate its two sides.

RE-FLUX each knuckle on both sides of the hinge.

LIGHT the torch and adjust to a gentle flame.

HEAT each knuckle slowly until the solder flows down the entire length of the knuckle.



Once you see the solder flow, immediately take away the heat and move it to the next knuckle.

Continue in this manner until each knuckle is completely soldered. This should be a fairly quick process.

PICKLE both parts of the hinge, and then rinse and dry them.

FILE the ends of the hinge flat so that the tubing does not extend past the sheet metal.

INSERT the wire into the hinge, joining the two pieces together.

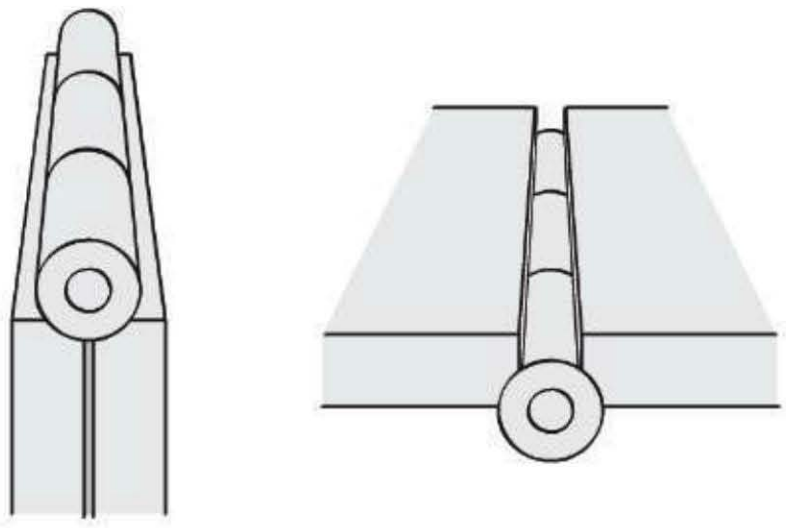
The hinge should freely move in both directions.

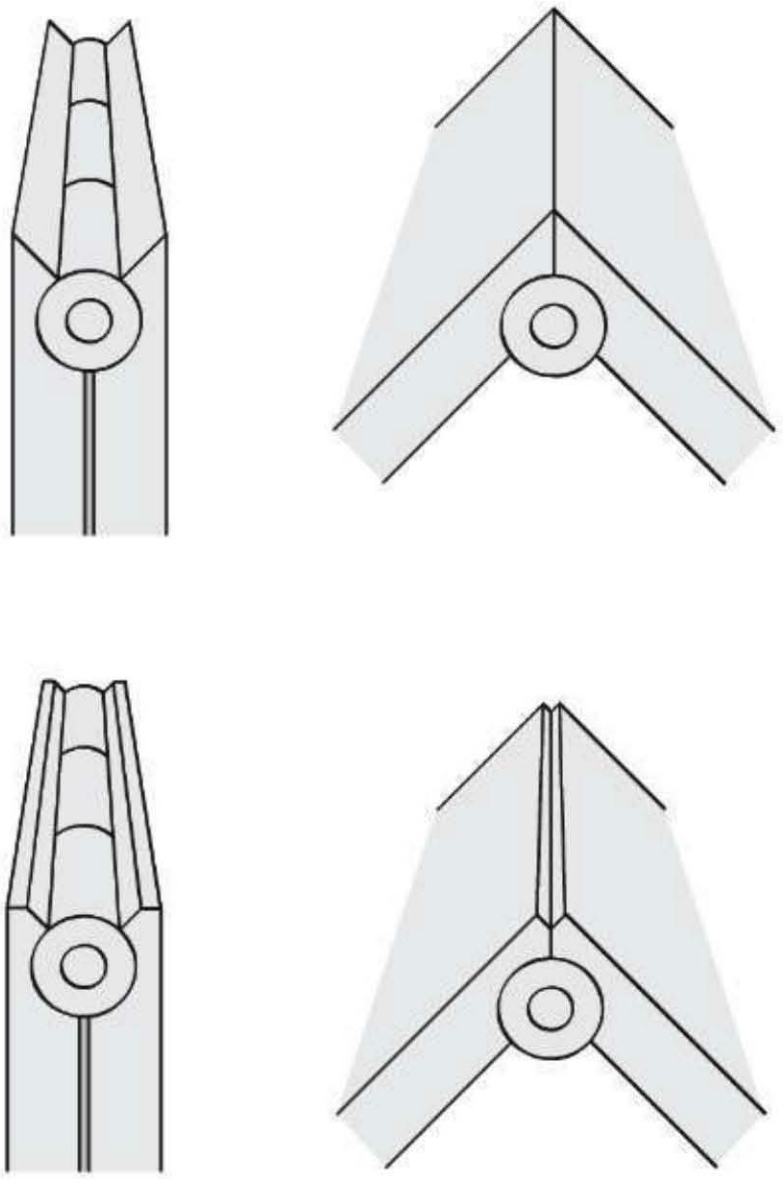
USE a jeweler's saw to cut the wire to a length that leaves approximately 1.5 mm of wire extending past each end of the hinge.

RIVET the wire to secure the hinge, or if you are extremely careful and confident in your skills, solder the wire at each end of the hinge.

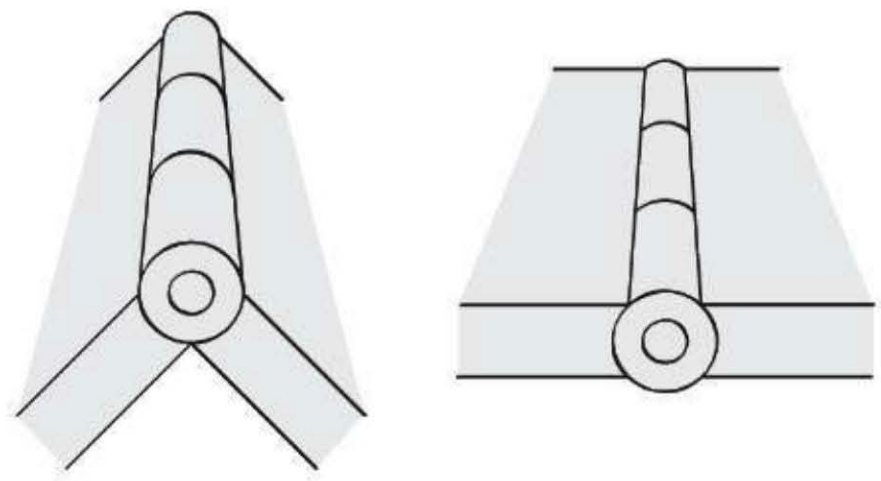
SMOOTH the rivet heads or the soldered ends of the hinge with 400-grit sandpaper.

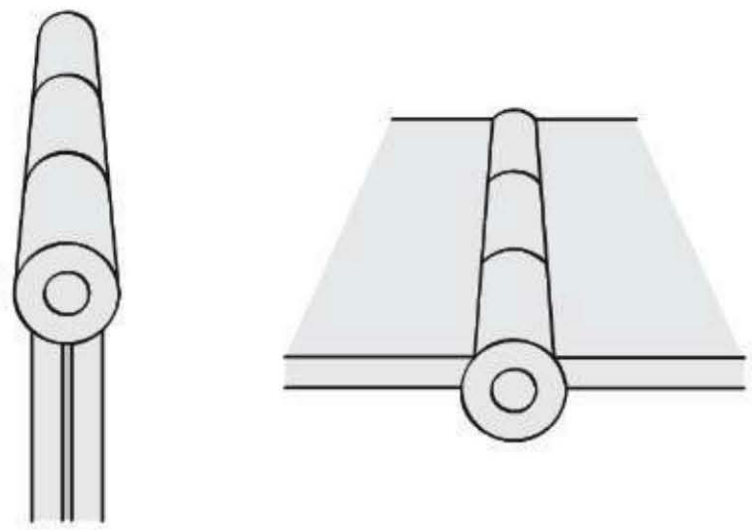
Samples of hinge placement, closed and open



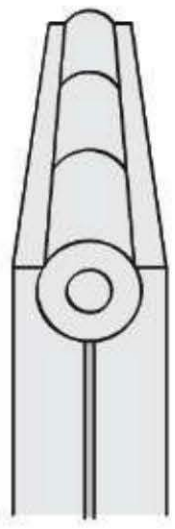


Samples of hinge placement, closed and open

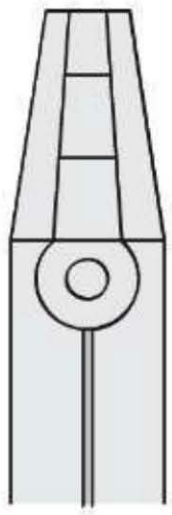




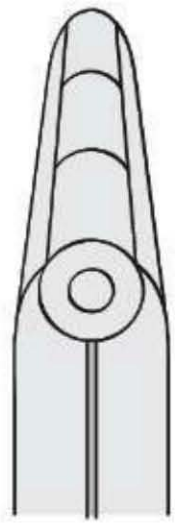
Options for hinge finishing



Soldered in place

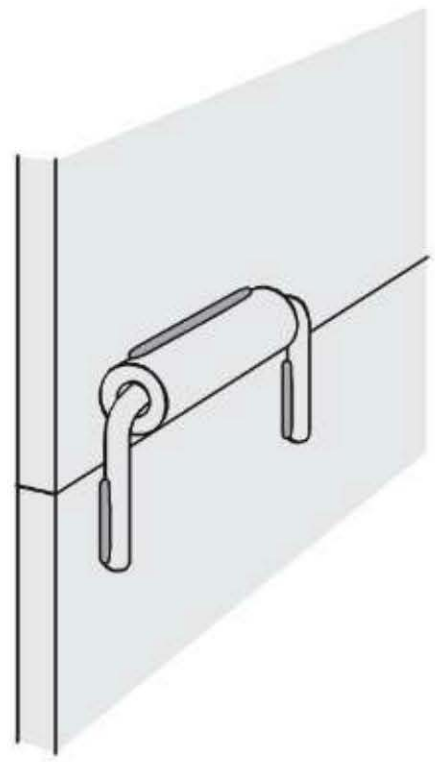


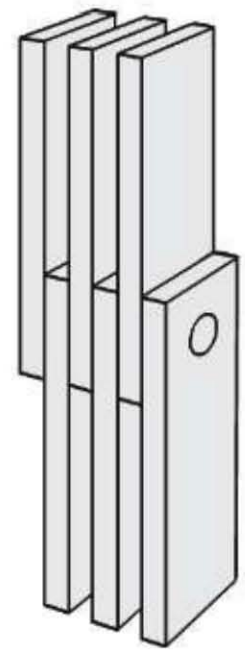
Filed flush



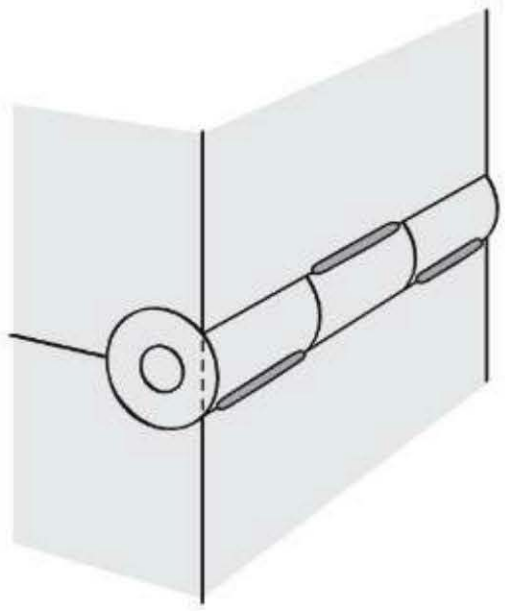
Filed round

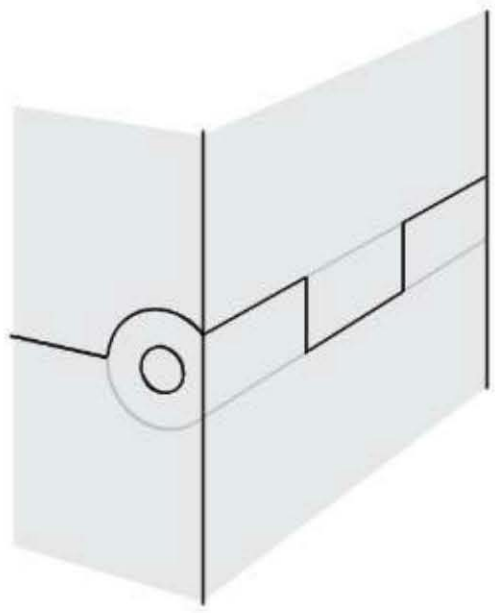
Other hinge options



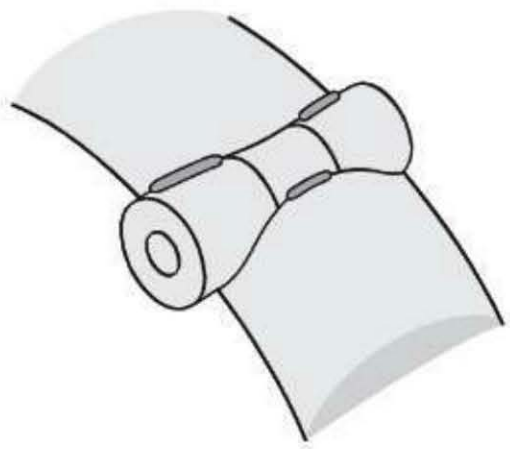


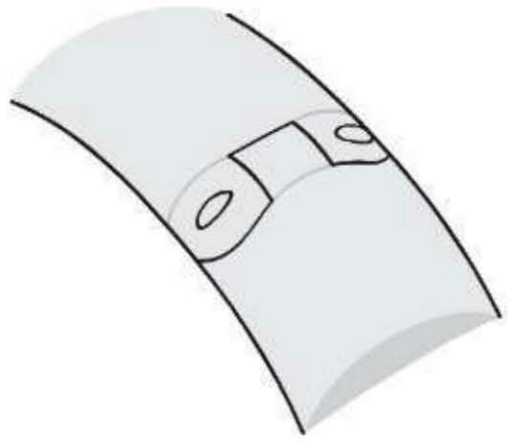
Flush hinge on a box





Flush hinge on half-round wire





Decorative hinge options

Drilled

Filed

Sawed

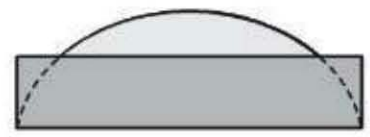
Stone Setting & Stringing

Metal and gemstones are a dynamic combination with each material intensifying the appearance of the other. Having the ability to set stones in jewelry opens up a whole new creative and colorful world to explore. Once you learn the standard methods and execute them well, you can even create original settings of your own design.

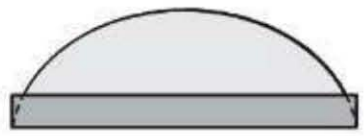
Bezel Setting

A bezel is a thin strip of metal that surrounds a stone to keep it firmly in place. Bezels can be made in any shape to fit around any stone. This includes irregular free-form stones, as well as oval, round, square, emerald-cut, or marquis ones. Bezels can be used to set cabochons as well as faceted stones.

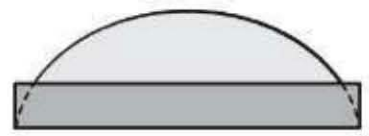
A bezel should be tall enough to cover the start of the curvature of the cabochon. If a bezel is too tall or too short, the security and beauty of the stone will be compromised.



Too tall



Too short



Correct height

New Tool

Bezel rockers and bezel pushers are hand tools used for setting stones. They are helpful for pushing a bezel over a stone to secure it.

Bezel Setting a Round Cabochon

The thickness of the bezel is variable. Choose the gauge of the metal based on the look you wish to achieve.

PROCESS

WRAP a 24- to 26-gauge bezel wire or sheet metal strip around the base of a cabochon to determine the proper length of the metal.

MARK the metal where the strip crosses its end (see photo, top).

CUT the metal at the marked point with a jeweler's saw or snips.

If snips are used, make sure to file the cut edge flat.

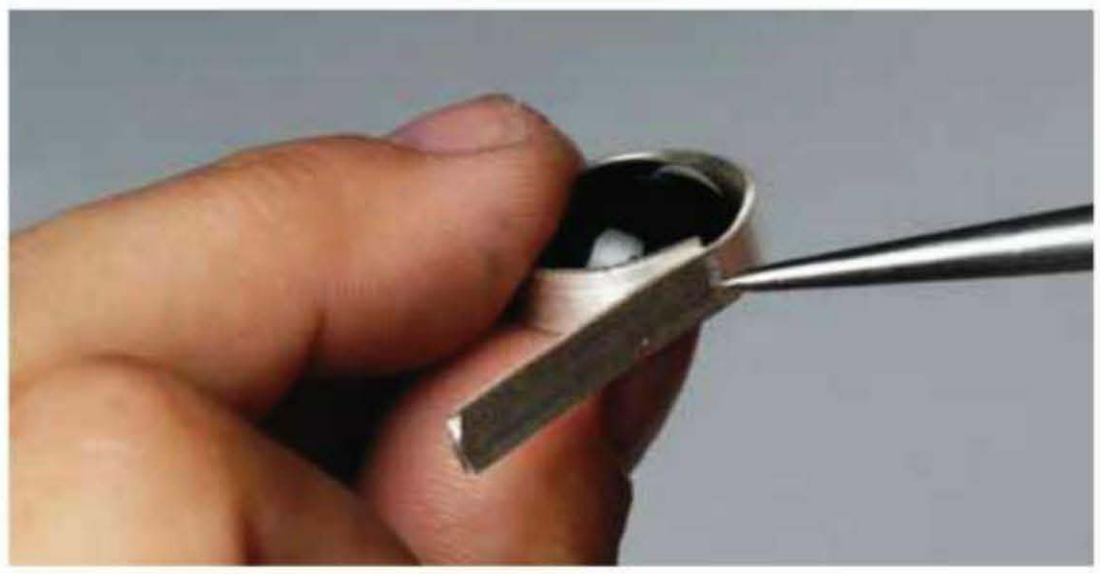
POSITION the two ends of the bezel strip to fit together perfectly.

SOLDER the ends of the bezel together with one small snippet of hard solder.

PICKLE and rinse the soldered metal, clean any extra solder from the joint, and sand the bezel to a 400-grit finish.

PLACE the bezel on a small mandrel, and lightly hammer it with a wooden or rawhide mallet to make it completely round, then shape the bezel around the stone.

SAND the bottom edge of the bezel flat.



CHECK the size of the bezel against the size of the stone to be set (see photo, bottom).

The stone should fit in the bezel from the top without being forced, and there should be a little room for movement. Too much room, however, is not good. The stone shouldn't be able to slide back and forth within the framework of the bezel.

SOLDER the bezel carefully onto the sheet metal or jewelry piece of your choice, making sure the solder joint on the bezel doesn't come unsoldered when the bezel is attached.

PICKLE and rinse the metal to which the bezel has been attached.

continued on following page

Bezel Setting a Round Cabochon

continued from previous page

PROCESS

COMPLETE the jewelry piece.

Setting the actual stone should always be the very last step. No soldering or other type of finishing work should have to be done after the stone is set. Cold working techniques that do not involve chemicals or abrasives are acceptable.

PLACE the stone in the bezel.

POSITION a bezel rocker or pusher at the 12-o'clock position on the bezel, and gently push a small amount of metal over the stone.

MOVE the rocker or pusher to the 6-o'clock position and push a small amount of metal over the stone.

REPEAT this action at the 3-o'clock position, and then finally at the 9-o'clock position on the bezel (top, left).

This clock method ensures that the stone is evenly held in place and prevents the bezel from crimping.

If you're bezel-setting a large stone, you may wish to repeat the process at 2 o'clock, 7 o'clock, and so on.

If you are using thick gauge wire for a bezel, a hammer handpiece can be extremely helpful at this point. Use a flat head attachment that has the edges softened. Hammer on the top of the bezel putting pressure down onto the bezel (top, right).

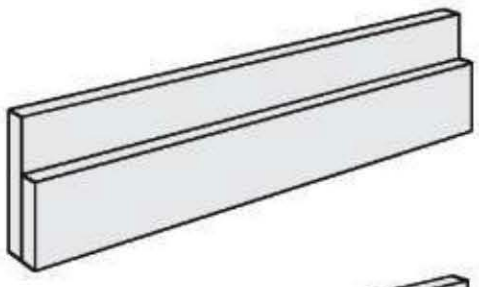
PUSH the remaining bezel metal over the stone with the bezel rocker.

USE a burnisher to make the bezel evenly snug around the stone, rubbing the metal in smooth strokes (bottom).

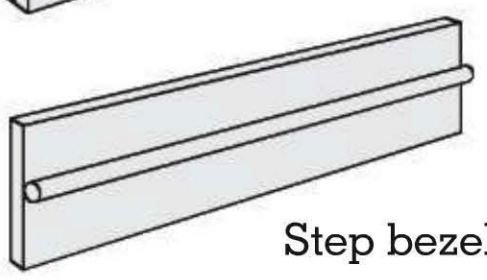
Burnishing will slightly polish the bezel. If you don't want a shiny bezel, gently and carefully finish it as you wish, making sure not to touch the cabochon with the finishing compound.

Making a Step or Raised Bezel

To make a stone appear taller than it actually is, use a step or raised bezel setting.



Step bezel made with sheet



Step bezel made with wire

PROCESS

CUT the bezel wire or strip for the setting taller than it needs to be, whatever height looks good for your jewelry design.

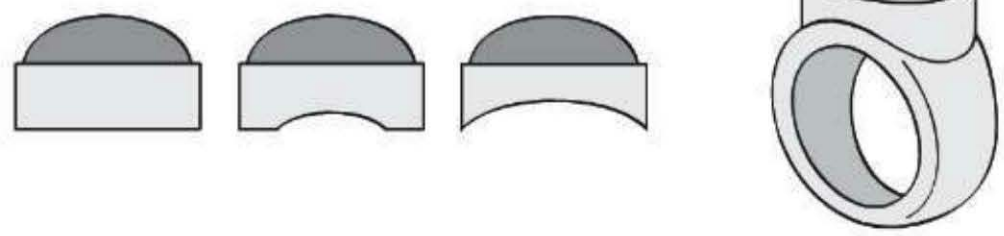
FORM, solder, and shape the bezel following the standard method described on pages 111 and 112.

FORM either a sheet metal band or a wire that fits perfectly inside the bezel.

SOLDER the band or wire inside the bezel at the appropriate height using hard solder.

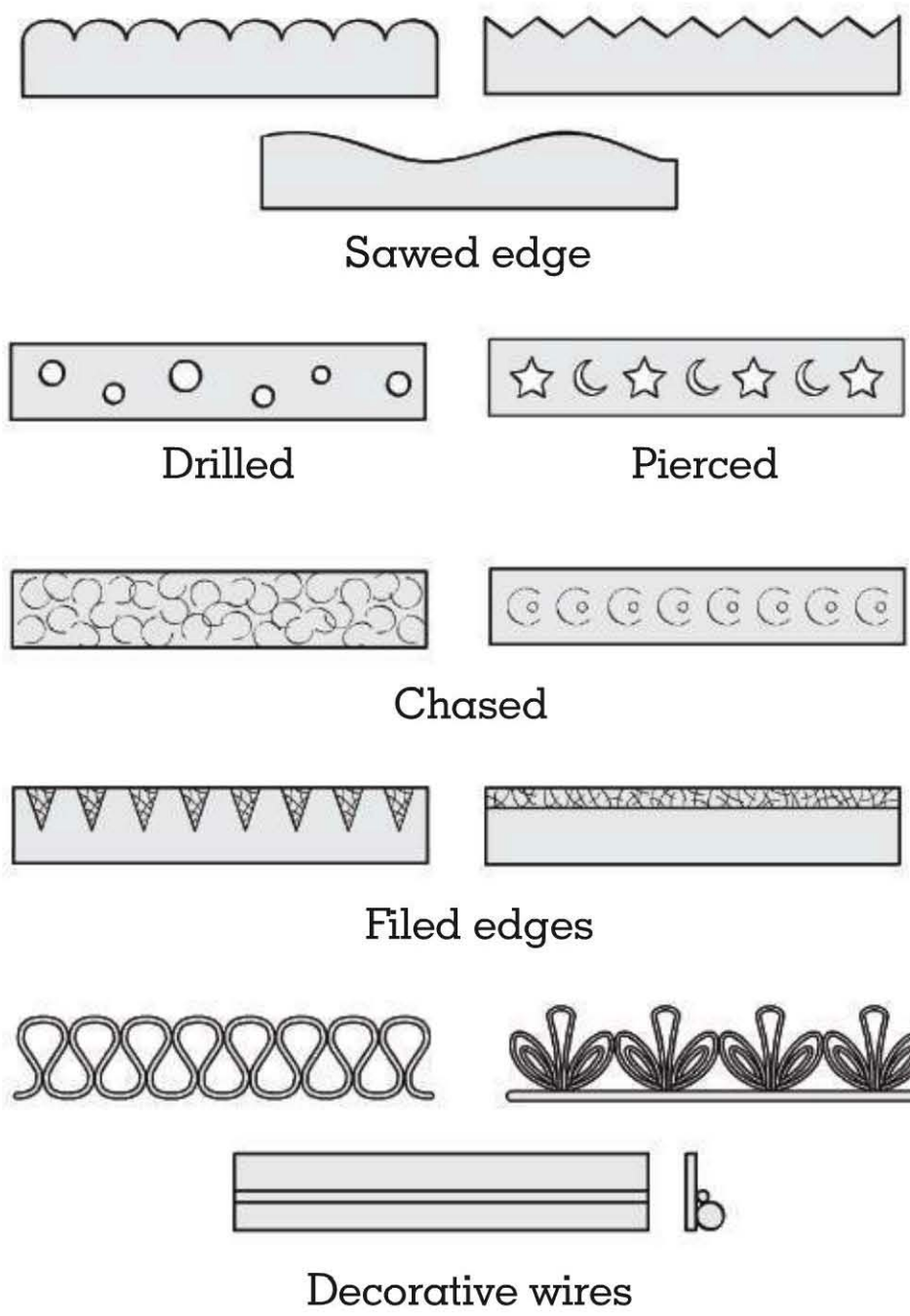
Attaching a Bezel to Curved Surfaces

To solder a bezel onto a curved surface, additional preparations need to be taken. The height of the bezel needs to be increased so that metal can later be removed from the bottom of the bezel. Fabricate the bezel as you normally would, and then use a curved file to remove the necessary amount of metal so the bezel fits snugly on the curved surface.



Decorative Bezels

A bezel doesn't have to be made of plain sheet metal. Decorative bezels can be interesting if they suit the jewelry design. You can chase, carve, or pierce and saw the material or use gallery wire for the bezel. You can also make a bezel out of shaped wire.



Sawed edge

Drilled

Pierced

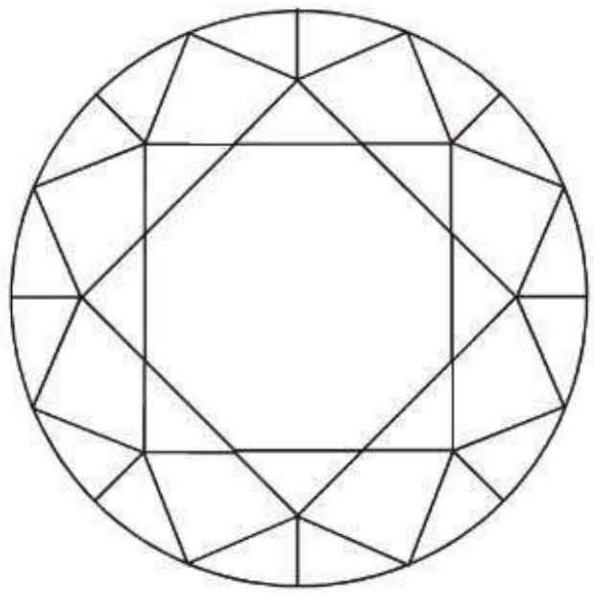
Chased

Filed edges

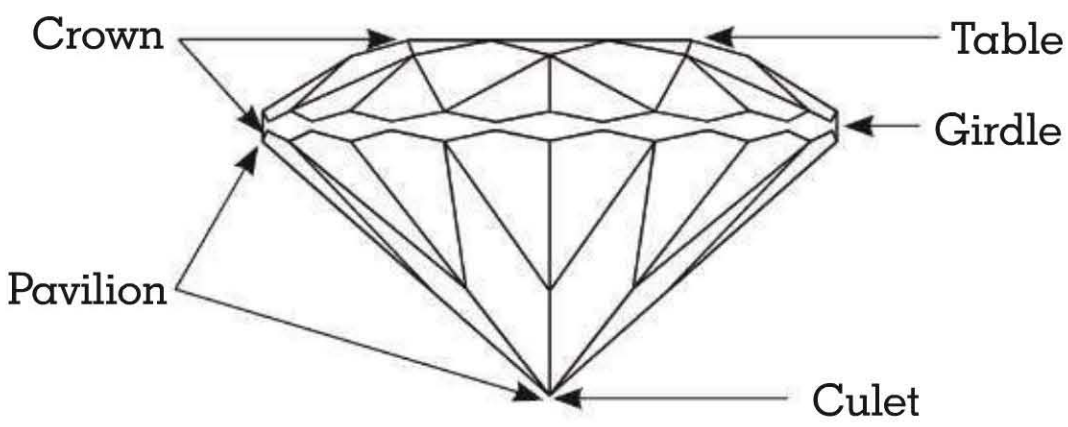
Decorative wires

Flush Setting

The term "flush" means that the table of the stone is flush with the surface of the metal and the girdle of the stone actually sits beneath its surface. A small amount of metal is pushed over the girdle to firmly hold the stone in place.



Top view of round faceted stone



New Tool

A setting tool has a rounded tip used for pushing metal to secure a stone.

Flush Setting a Stone

You can use a flush setting to secure small (0.5 to 3.5 mm), round cut stones.

PROCESS

MEASURE the size of the stone to be set with digital calipers.

SELECT a piece of metal that is at least 0.75 mm thicker than the distance from the table to the culet of the stone

DETERMINE and mark a location for the setting on the metal.

DRILL a hole in the metal at the marked point that is at least 0.75 mm smaller than the diameter of the stone.

SELECT a 90° hart burr that is approximately 0.1 mm smaller than the stone to be set.

Using the correct size burr is essential for flush setting stones. It's better to use a burr that is too small than one that is too large. (After using a smaller bur, you can slowly grind out the area that needs to be larger. You cannot, however, always find a larger stone to fit a hole that has been burred too large.)

INSERT the burr into the flexible shaft and slowly begin to make a seat for the stone at the drilled point the metal.

Dip the burr in beeswax or oil as needed for easier cutting.

CUT out the seat until the girdle of the burr is just below the surface of the metal.

You can mentally equate the girdle of the burr with the girdle of the stone.

PLACE the stone to be set in the burred hole. (The stone should make a slight noise, a "snap," when it fits into the hole.)

USE the setting tool to press down and push the edge of the metal over and around the stone.

It's fine if you touch both the stone and the metal with the tool.

MAKE firm circular motions with the setting tool as you work around the edge of the stone.

When setting a soft stone, be careful to put most of the pressure on the metal, not the stone itself.

WORK around the edge of the stone several times in both directions until the stone is secure.

TEST the stone to verify that it is firmly set.

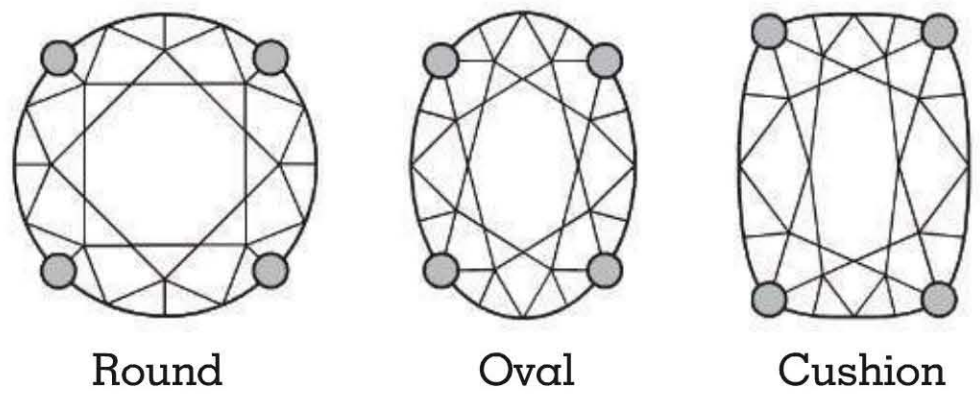
To test the setting, place any type of attachment in the flexible shaft and turn it on. As it rotates, hold the shaft of the attachment against the metal to make a slight vibration. If the stone begins to move, it is not set tightly enough. If it stays in place, chances are the setting is secure. You can also use tweezers to manually try to move the stone. While wearing magnification, try to move the stone and see if any light bounces off the stone in an uneven manner.

Classic Prong Setting

Prong setting is one of the most common types of stone setting. Prong setting allows more of a stone to be seen, as less metal is used to secure the stone in place. There are many ways to prong set stones, and stones with different shapes can require different setting practices.

Many factors must be thoughtfully considered when designing prongs. A very high setting must have thicker, stronger prongs than a lower setting, which can have thinner prongs. A larger, more expensive stone may need six prongs to hold it securely instead of four. Similarly, a larger stone may require prongs that have a wider surface area of metal. When designing a setting, always err on the side of caution. At all times, the most important factor is that the stone is held firmly in place. Attractiveness, though extremely important, always comes second.

Traditional prong placement
for different faceted stone shapes



Prong Setting a Stone

The process described below is for prong setting a round faceted stone, but many of the procedures can be used for setting stones of other shapes.

PROCESS

ENSURE all prongs are of equal height and are evenly spaced.

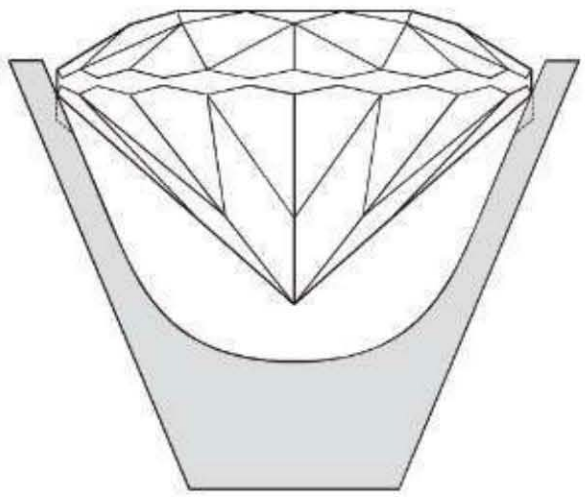
If needed, adjust the spacing by gently bending a prong with chain-nose pliers.

File the prongs to an equal height.

Sometimes, if there is enough metal on the prongs, you can use your chain nose pliers to gently stretch the metal to make the prongs longer.

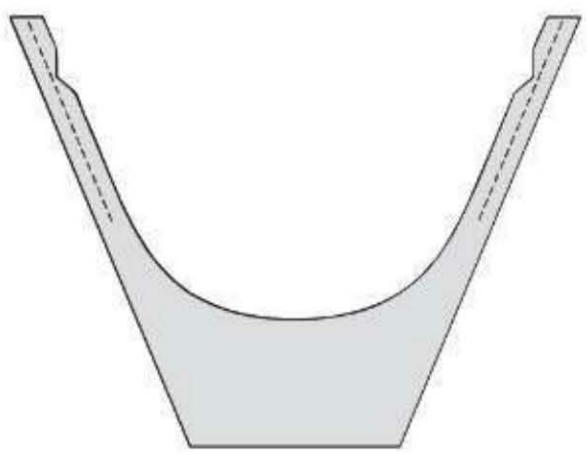
SHAPE the tips of the prongs with a cup burr or a file and remove all metal burs.

DETERMINE where the girdle of the stone will sit on each prong, and use dividers to mark these points.



The line made by the dividers marks the bearing, which is part of the seat.

USE a hart burr, a setting burr, or a file to cut the bearing for each prong, one at a time, about halfway through.



The hart burr and the setting burr should be smaller than the size of the stone and should fit inside the setting without touching the other prongs. If you use a burr that is the same size as the stone, the setting may be ruined by the burr twisting against all the prongs at one time.

Always use wax or oil on the burr for each cut.

If the prongs are thin, cut less than halfway into the prong. The prongs need to have enough metal at the bearing point to be strong enough to hold a stone, but also malleable enough to bend over the stone without causing damage.

PLACE the stone in the setting so the girdle rests on the slanted part of the cut bearing.

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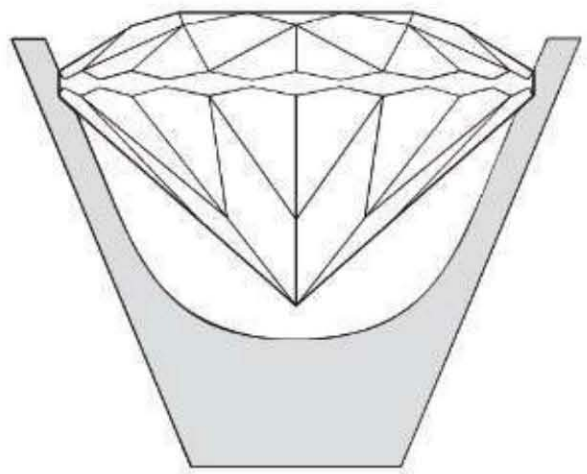


Prong Setting a Stone

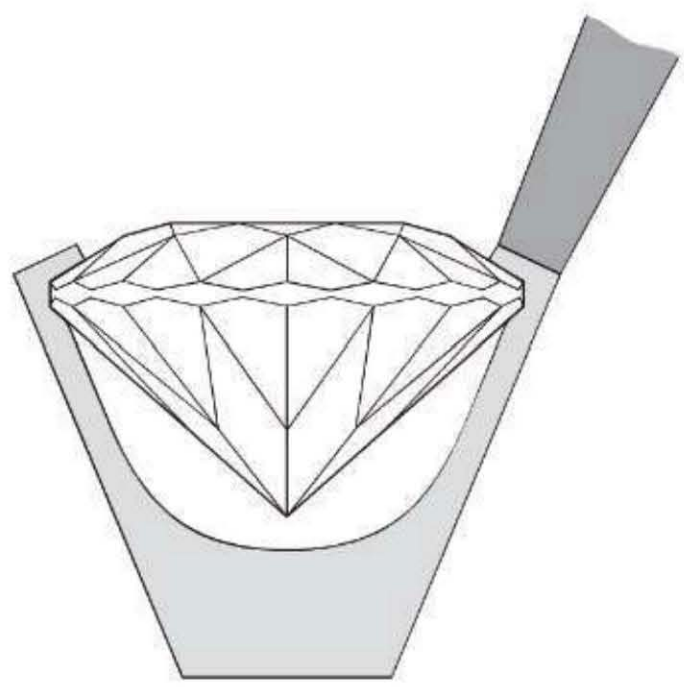
continued from previous page

PROCESS

SQUARE the stone in the prongs.

This gives the stone a more attractive look, as it appears more uniform to the eye.

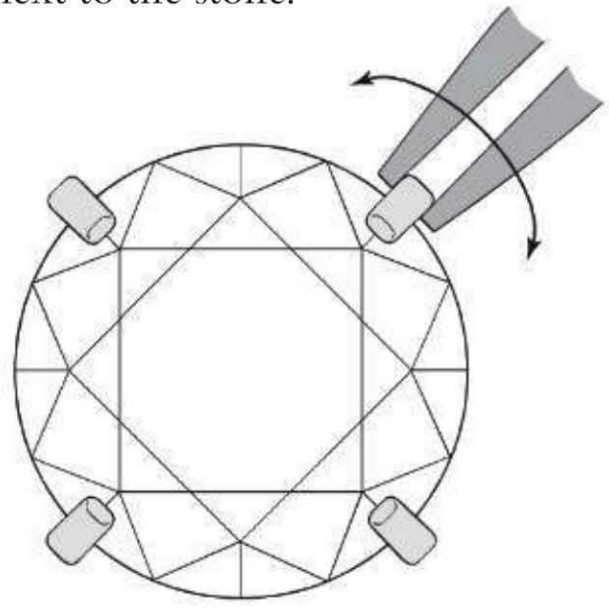
USE chain-nose pliers or a prong pusher to push the prongs over the stone, closing opposite prongs first.



If using chain-nose pliers, hold the opposite prongs in the pliers, push one prong over the stone with the tip of the pliers, and then switch and push the opposite prong over the stone. Repeat with the remaining prongs.

The girdle of the stone should now be resting correctly in the bearing.

TIGHTEN the stone by gently rocking the tip of each prong back and forth with chain-nose pliers until the prongs rest firmly next to the stone.



Use magnification if necessary to ensure that each prong tip is next to the stone with no gaps.

RESHAPE the prong tips with a needle file if desired.

CLEAN each prong and remove all scratches with a pumice wheel attachment on the flexible shaft.

PLACE the stone setting in the ultrasonic cleaner for a final cleaning.

Alternative Prong Setting

You can create unique prong settings for original designs and they can be as nontraditional as you like. An alternative setting must have three parts: a seat, prongs, and a place to attach the setting to the piece of jewelry. The most important factor is that the stone (or other object) be securely held in place.

New Tool

Impressionable soldering blocks can help you as you construct your settings, or you can drill holes in a compressed charcoal block to hold the prongs in place while you solder.

A third hand and/or extra pairs of cross-locking tweezers are also helpful when positioning an unconventional setting to solder.

Stringing

There are many ways to string beads. For professional quality jewelry, a well-strung, professional-looking bracelet or necklace is essential. This is an easy skill to acquire and is well worth the extra time and effort.

New Tool

Crimping pliers are specifically used to finish the ends of a strung piece of jewelry. The pliers tighten crimping beads in a precise manner that secures the stringing.

Beading String Types

Tigertail

An excellent, all-purpose choice for stringing, tigertail (photo, right) is not a single wire, but seven to 12 strands of very thin steel wire bundled and coated with a layer of plastic. Tigertail is extremely durable, water resistant, and sold in several sizes. The only drawback to tigertail is that if it is bent often, it will eventually break.

Silk Thread

Choose silk thread when stringing nice pearls. Silk must be handled with care. It will easily fray, it stretches, and cannot get wet.

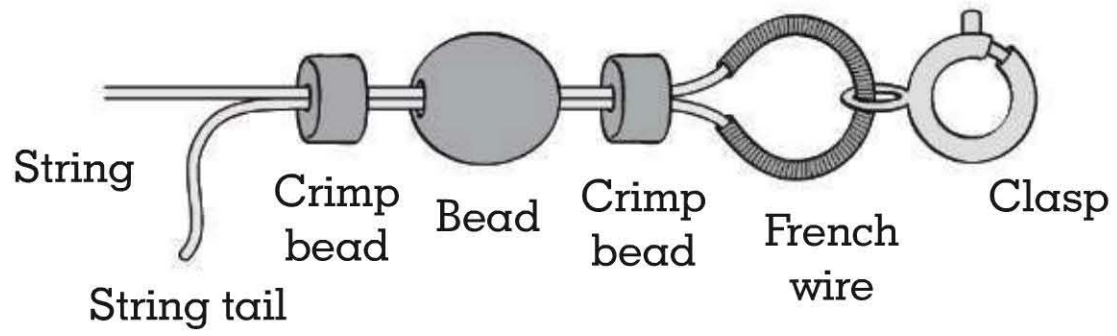
Polyester Threads

Polyester thread is a good choice for stringing less expensive natural beads. The threads come in many different colors, which can add an extra design element to your piece. Polyester threads are not supposed to stretch, but they eventually will.

Basic Stringing

Note: The French wire used in bead stringing is a specific type of wire (not to be confused with French ear wires, which are a particular finding style).

Using Crimp Beads at the End of Stringing



PROCESS

CUT a length of string that is approximately 5 inches (12.7 cm) longer than the length needed.

It's always better to err on the side of caution and cut too much string rather than too little.

THREAD onto one end of the string:

- one crimp bead
- one bead of your choice
- a second crimp bead
- a section of French wire, about ¼ inch (6 mm) long (depending on the gauge of your clasp)
- one side of your clasp

MAKE a loop and re-thread the string back through the crimp bead, the bead of your choice, and the remaining crimp bead.

TIGHTEN the thread so the French wire begins to bunch up slightly.

The clasp section should move freely in the loop that is covered by the French wire.

USE crimping pliers to firmly compress the crimp beads.

SNIP off the excess tail of the string.

A small pair of nail clippers is extremely useful for this purpose.

STRING the rest of the beads except for one.

THREAD the second end of the string to match the first.

MAKE a loop and re-thread the string back through the crimp bead, bead of your choice, and the remaining crimp bead.

TIGHTEN the thread so the French wire begins to bunch up slightly.

USE crimping pliers to firmly compress the crimp beads.

SNIP off the excess tail of the string.

Classic Pearl Stringing

If a jewelry design calls for the traditional type of pearl stringing and knotting, there are several techniques you need to know. The most important one is how to appropriately and securely finish this type of stringing.

PROCESS

CUT a length of silk thread that is approximately 10 inches (25.4 cm) longer than the length you desire.

The clasp will add some length to the piece, so be certain to plan ahead.

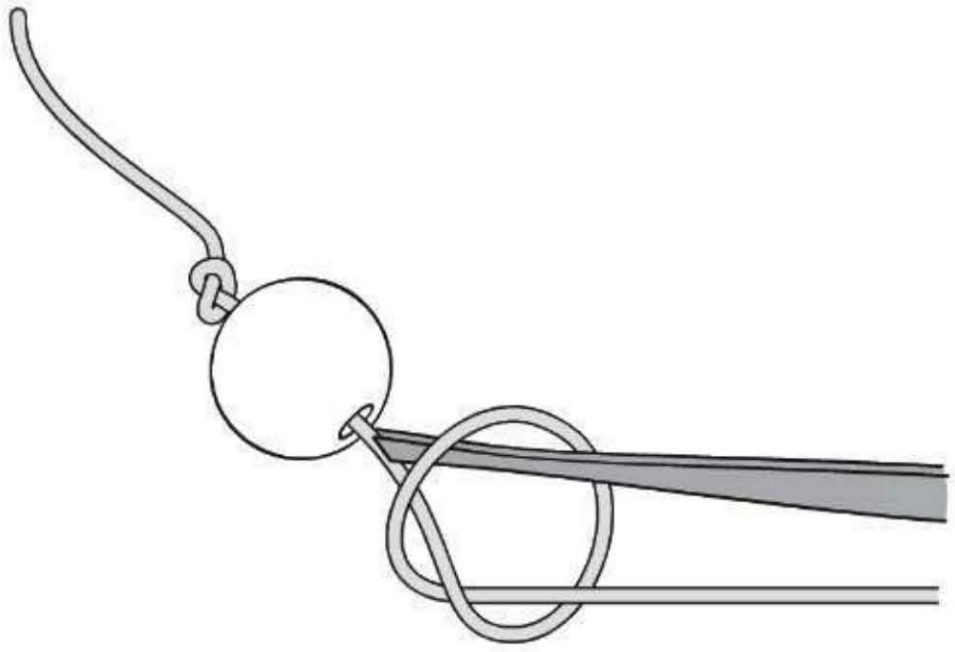
TIE a simple knot in the thread, approximately 5 inches (12.7 cm) from one end.

USE a needle to string a pearl onto the long end of the thread.

Often, silk thread will come with a needle attached.

TIE a loose knot near the pearl.

INSERT clean tweezers into the knot and hold the thread at the exact place where the knot will be (see illustration).



PULL the thread tight around the tweezers, remove the tweezers from the knot, and then use the tweezers to simultaneously push the knot into place and tighten it.

CONTINUE threading and knotting each pearl until all—except the two that will go on the ends—are strung.

DRILL the two remaining pearls if needed (see tips on next page) with a 0.75-mm bit to enlarge their holes so the thread is able to pass through the holes twice and secure the pearls in place.

STRING one pearl on the end of the silk thread.

ADD approximately ¼ inch (6 mm) of French wire and one end of the clasp to the silk thread.

FEED the silk thread back through the pearl.

TIE another knot tightly against the pearl, making certain to tighten the French wire and leave the tail of the thread.

REPEAT the preceding four steps on the other end of the silk thread with the second part of the clasp.

ADD a tiny drop of watch-face glue to the knots that touch the last pearl.

The tube of watch-face glue should have a syringe tip that dispenses the glue exactly where it is needed.

Make sure the glue saturates the thread, but be careful not to get any on the pearl.

LET the glue dry for several hours, and then snip off both tails of the thread.

Tips

- You can use a regular drill bit lubricated with oil or beeswax to drill a hole in a pearl. Make sure to drill the hole slowly so the surface of the pearl doesn't get marred.

- If you're drilling very expensive pearls, you might want to invest in a diamond-coated bit, which is a safer choice than a regular bit. (You can use the diamond bit to drill though other stone beads. Make sure to dip the bit into water or oil when drilling other types of stones.)

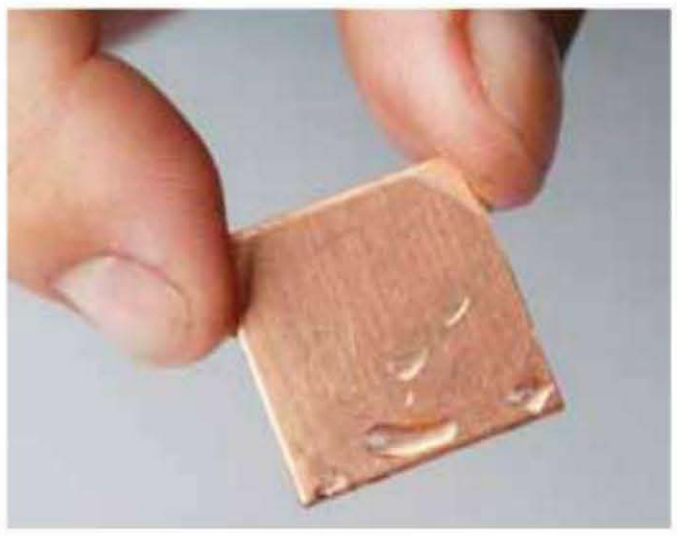
- The most important characteristic of watch-face glue is that it does not dry brittle. The glue has some play in it even when dry, so the movement of the jewelry on the body will not cause the thread to break at the glued point. This is very important. Do not try to substitute another kind of glue for stringing pearls, especially not two-part epoxy. If you do, the thread will surely break.

Finishing Techniques

The superficial appearance of a completed jewelry piece is known as its finish. Determining and executing this feature is an important part of good design, and there are many finishing options to choose from. Metal can be polished to a mirror-like shine or made matte to reduce its luster. Finishes can have a high or low texture. The tone of the metal can be altered through chemical patinas, heat treatments, and other coloring agents.

Cleaning Metal

Metal needs to be completely clean before many different processes, such as enameling and kum boo, can be executed. If water beads up on a metal surface (photo, left), then dirt or oil is present. Water sheeting off the surface is a good indicator that the metal is clean (photo, right).



PROCESS

HOLD a metal sheet by its edges to avoid getting finger grease on its surface.

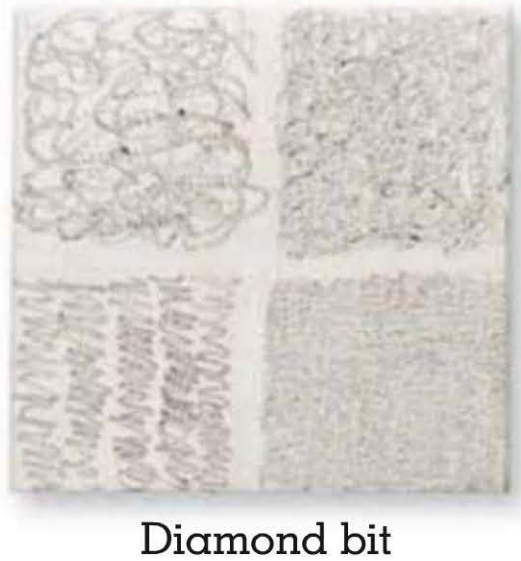
SCRUB the metal under water with pumice or an abrasive household cleaner.

A green kitchen scrub pad, sandpaper, or steel wool can be rubbed on the metal while dry.

RINSE and dry the metal thoroughly.

Sample finishes on sterling silver sheet

Flex shaft with brown bristle disk



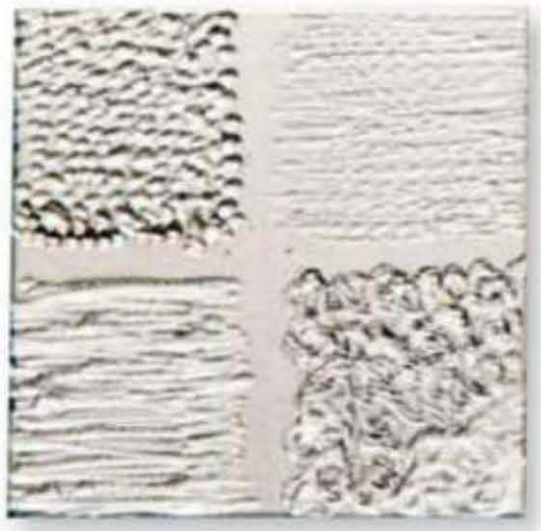
Diamond bit

Flex shaft with steel brush

Steel wool

Green kitchen scrub pad

Flex shaft with fiber wheel

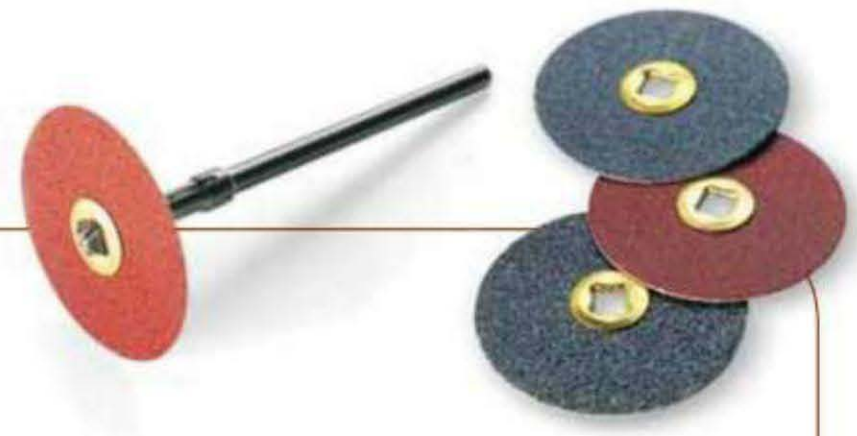


Round burr

220-grit sandpaper

400-grit sandpaper in one direction

Sanding



Before finishing metal, you must prepare it by sanding out any unwanted file marks or scratches. There are several techniques for sanding metal. Hand sanding is the most labor-intensive and time-consuming approach. Using a sanding attachment on the flexible shaft is easily the most efficient method. A variety of sanding disks (top) are made to snap onto a mandrel that fits in the flexible shaft. Split mandrels are also made for the flexible shaft. Here, a strip of sandpaper is inserted into the slit on the mandrel and wrapped around the mandrel. Plastic bristle disks (bottom) and heatless wheels can also be used for sanding. Experiment with these options to determine which works best for you.

PROCESS

SAND with 220-grit sandpaper to remove most scribe lines and deeper surface marks.

SWITCH to 400-grit paper and completely sand over the first pass.

It's a good practice to sand with the 220-grit paper in one direction, and then sand over that area in the opposite direction with the 400-grit paper. This way it's apparent when a piece has been thoroughly sanded with the finer grit.

SAND with 600-grit sandpaper if desired.

This step is unnecessary unless you are aiming for an extremely high final polish.

Matte Finish

A matte finish reduces metal's luster. To achieve this finish by hand, rub 400-grit wet/dry sandpaper, steel wool, or a green kitchen scrub pad back and forth or in a circular motion on the surface of the metal.

New Tool

A motorized tumbler can be used to create a uniform matte finish. There are several products that can be added to the machine to enhance the finish, such as a plastic cone media and de-burring compound. Simply place the metal items in the tumbler with the media, water, and de-burring compound, and let the tumbler run overnight. The tumbler can be run for less time if desired. Monitor the results and keep track of the variables to achieve the ideal finish. Experiment with various media to see what kind of finish they produce.

Shiny Finish

There are many methods, both manual and mechanical, for generating a shiny finish. The most low-tech approaches are to use a soft-bristled brass brush or a polishing cloth (below). Fine steel wool will also produce a bit of a shine. Using steel brush attachments (below, right) with the flexible shaft will create a shiny finish in less time with less effort. However, the most efficient and effective way to shine metal is in a tumbler or with a polishing machine.

Tumbling for Shine

Stainless steel shot shines metal by constantly bombarding it with different shapes of shot. The shot is actually burnishing the metal with each hit.

PROCESS

LOAD mixed stainless steel shot into the barrel of the tumbler.

The shot must be stainless steel so it won't rust.

Use approximately 2 pounds (0.9 kg) of stainless steel shot for a ½-gallon (1.9 L) tumbler.

ADD just enough water to the tumbler to cover the shot.

PUT a drop or two of liquid dishwashing soap into the tumbler.

The dishwashing soap helps the steel burnish the metal more gently.

PLACE the metal jewelry to be polished into the tumbler, and turn on the machine.

WAIT several hours, and then stop the tumbler and check the shine on the piece.

CONTINUE tumbling the metal until the desired shine is achieved.

Machine Polishing

A polishing machine produces the shiniest surface. With a polishing machine and the right compounds and wheels, you can achieve a true mirror finish.

Using a Polishing Machine for a High Shine

Three levels of polishing media (tripoli, bobbing compound, and rouge) and three cotton buffing wheels (one for each polishing media) are needed. It's wise to have a buffing wheel, not only for each polishing compound, but also for each type of metal. It's especially important to have separate wheels for steel items, as steel from the polishing wheel can become imbedded in softer metals.

PROCESS

PUT on safety glasses to protect your eyes.

TURN on the machine and gently place the hole of the cotton buffing wheel on the rotating spindle.

RELEASE the buffing wheel and it will rapidly turn into place due to the centrifugal force of the motor.

RUN a block of Tripoli compound against the buffing wheel.

HOLD the piece of jewelry to be polished firmly in both hands, about one-quarter of the way down from the center of the buffing wheel.

PRESS the piece gently against the buffing wheel while rapidly moving it around to ensure an even polish.

continued on following page

Using a Polishing Machine for a High Shine

continued from previous page

PROCESS

The polishing compound actually removes metal, so don't hold the piece in one place for very long or ruts will form on the surface.

TURN off the machine and remove the buffing wheel from the spindle.

REPEAT this process with a second buffing wheel and the bobbing compound.

REPEAT this process with a third buffing wheel and the rouge compound.

REMOVE all polishing compound residue by gently scrubbing the polished metal with a soft bristle toothbrush and some degreasing dishwashing liquid or by letting the piece soak in an ultrasonic cleaner (below).

Patinas

Many metals naturally develop a patina, a change in coloration, through exposure to the elements. For jewelers wishing to deliberately color the surface of metal, there are many products and techniques available. Silver, copper, and brass take patinas quite easily, while gold, platinum, titanium, and niobium do not. This disparity can be useful in creating dramatic designs. For example, when a mixed metal piece is oxidized, the silver parts will blacken but the natural color of the gold parts will be unaffected.

Sterling silver blackened with liver of sulfur

Blackened sterling silver rubbed with a brass brush

Copper blackened with liver of sulfur

Blackened copper rubbed with a brass brush

Brass blackened with liver of sulfur

Blackened brass rubbed with a brass brush

Using a Liver-of-Sulfur Solution

The most common way to blacken metal is with a liver-of-sulfur solution. This simple process adds color and depth to jewelry and makes surface designs more visible. Silver, brass, and copper are the metals that are most receptive to this patina. Liver of sulfur has a strong odor, so you must use it outside or in a well-ventilated area.

PROCESS

ADD hot water to a glass bowl.

PUT on rubber gloves to protect your hands.

DISSOLVE one chunk of liver of sulfur in the hot water.

DROP the piece of jewelry to be blackened into the solution.

LEAVE the jewelry in the liver-of-sulfur solution until it turns black, approximately one to two minutes.

If the piece is left in the solution for too long, the black color becomes a thick crust that can eventually flake off the metal.

REMOVE the jewelry from the liver-of-sulfur solution with copper tongs.

WASH the blackened metal in hot water.

The hot water helps the patina adhere to the metal.

REPEAT this process as needed to produce a darker black color.

Tip

Rubbing the blackened metal with an abrasive such as steel wool, a coarse cleanser, or a green kitchen scrub pad produces an attractive finish that lets the some of the metal's natural color and luster show through the dark patina.

Sterling silver | Copper | Brass

Oxidation

Some metals will change color from oxidation brought on by the deliberate application of heat. Copper reacts especially well to this process. It is important to know that heat patinas are not permanent, they must be sealed, and that the colors produced will change when the sealant is applied.

PROCESS

LIGHT your torch and run the flame over the metal until the color changes.

STOP heating immediately once the color of the metal changes.

LET the oxidized metal air cool.

SEAL the oxidized metal with clear lacquer or wax.

Coloring Metal

You can draw directly on a piece of finished metal jewelry with colored pencils, markers, or paints. These materials provide an unlimited color palette resulting in jewelry with amazing finishes. Try adding color to metal that has been sanded or roughened in some way, as well as to material that has been polished, to see the various results. When working with colored pencils, you can seal a layer of color, add more colored pencil, then seal that layer, et cetera, until you have a layer of color that is a millimeter or two thick. This color layer can make for an interesting texture as well.

Wax crayon

Colored pencil

Spray paint

Permanent marker

Sealing

Sealing a patina, heat treatment, or finish will extend the life of the color on the metal. Common sealants used on metal include wax and lacquer. There are waxes available from jewelry suppliers specifically for this purpose. A thin, light wax works best on jewelry. Experiment with a variety of commercial lacquers and fixatives to see which one works best for you.

Safety

Nothing is more important than your health and personal safety. Always fully understand the tools and materials you are working with and take all precautions recommended by the manufacturers. Wear the appropriate body protection at all times. Taking the time to completely read, comprehend, and enact all user guidelines, safety warnings, and operating directions is your most valuable investment.

Mechanical Safety & Maintenance

It is imperative to take proper care of your tools. Regular maintenance will ensure a long working relationship between you and your tools, and more importantly, will ensure your own physical safety. Accidents and injuries can be prevented through tool care and knowledge.

Tips

Keep instruction and safety manuals for all new tools organized in a secure, central location.

Locate and obtain manuals for used tools from the Internet or from the tool manufacturer.

Closely follow all instructions for setting up a tool and follow the manufacturer's recommendations for maintenance.

Regularly dust your tools and oil machinery with household oil. If a mechanical tool is used daily, such as a flexible shaft, regular maintenance should be performed on the tool at least every six months. For less frequently used tools, once a year is sufficient.

Once a Year

• Oil all steel tools with a soft rag and regular household oil.

• To ensure tight fitting hammerheads, soak steel hammers with wooden handles upside down in motor oil for a few days. Important: Never use linseed oil in a jewelry studio. This type of oil can self-combust.

• Buff all stone setting tools and daps on the buffing machine to a high polish, taking care not to change the shape of the tools.

Fire Extinguisher

You must have a working fire extinguisher located next to your soldering area at all times. Check the extinguisher every six months to make sure it is properly working. Your local fire department will recharge the extinguisher at no cost.

Electrical Cords

Have a certified electrician make sure all electrical outlets are in proper working order. Use only three-prong, grounded extension cords. When plugging in multiple cords, use a power strip with a safety switch. Do not run a long chain of multiple cords plugged into other cords. It's well worth the money to hire an electrician to set up new outlets as needed.

Flexible Shaft Maintenance

In addition to regularly oiling the handpiece and machine motors with flexible shaft oil, you need to grease the shaft annually and test and replace the brushes as needed.

PROCESS

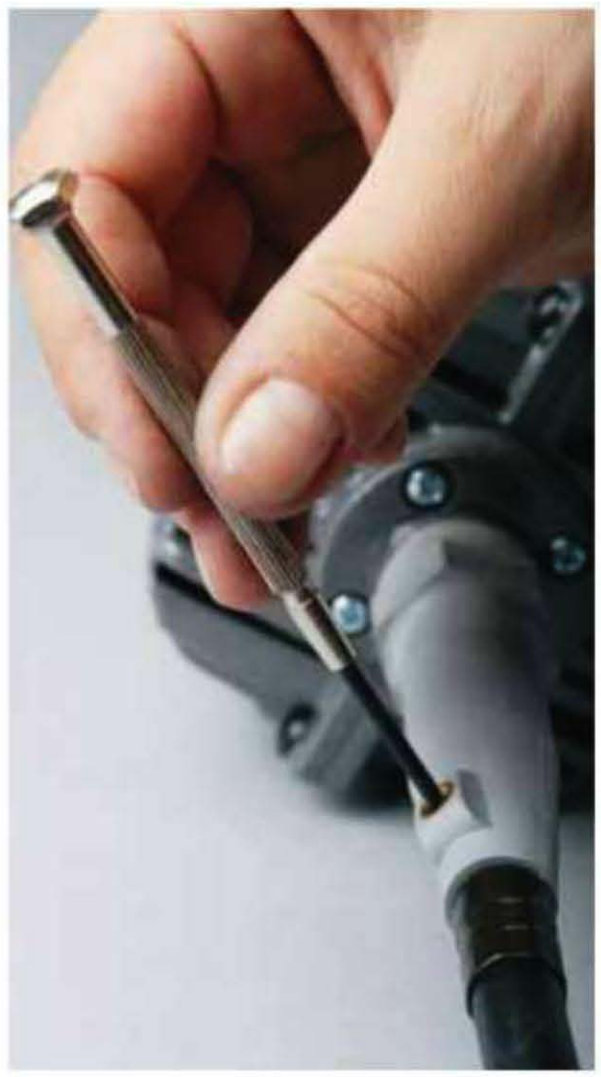
UNSCREW the screw at the top of the shaft (top, left).

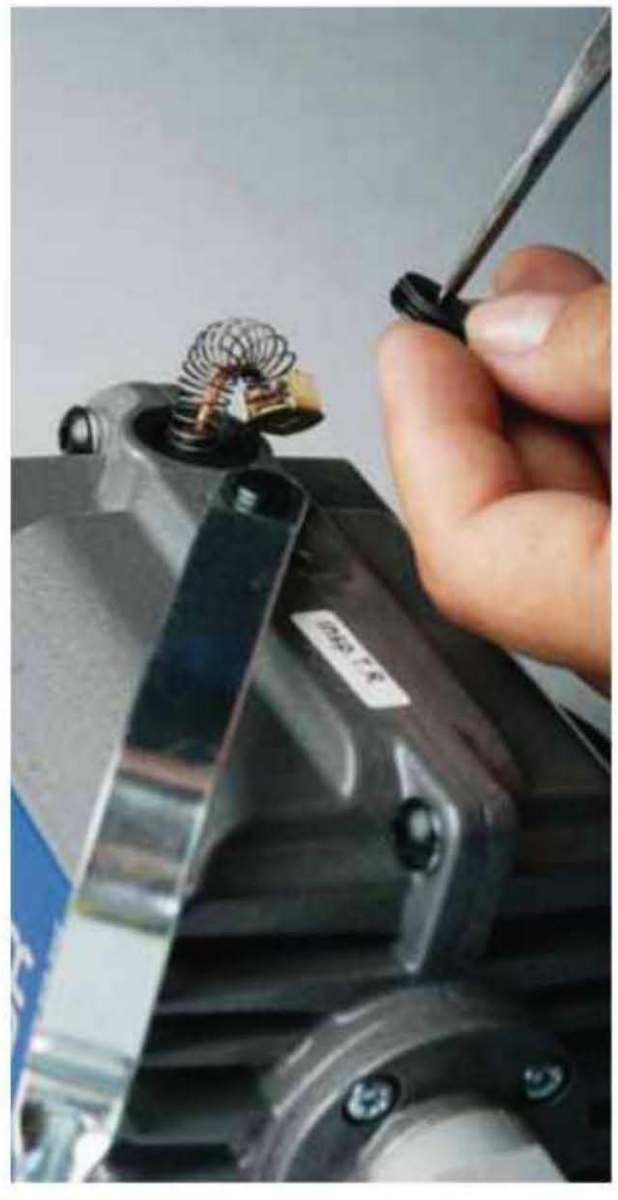
REMOVE the plastic sheathing from the shaft of the machine (top right).

RUN a light line of flex shaft grease all along the twisted wire (bottom left).

RE-ATTACH the sheath.

To test the flex shaft brushes, unscrew the screws on the side of the machine (bottom right). Healthy brushes will be about 1 inch (2.5 cm) long. If your brushes appear worn down and are much shorter than 1 inch (2.5 cm), order a set of replacement brushes. Simply slide the new brushes in place of the old brushes.





Chemical Safety & Maintenance

Acids

Make sure to have a Material Safety Data Sheet for every acid in your studio. This sheet details all necessary emergency information, such as what to do in case of eye contact or ingestion for each acid. Material Safety Data Sheets are available from the acid supplier. Make certain to read all sheets carefully and keep them on file.

Store all acids in a cool, dry place. It's best to store acid in a low position in case of spillage. A low location decreases the risk of acid either falling onto a person or spreading over more area than necessary.

• Most important rule:
ALWAYS add acid to water.
NEVER add water to acid.

• Only use acids in a well-ventilated area.

• Wear rubber gloves when handling acid.

• Wear eye protection in case of splashes.

• Wear a rubber or waxed apron to protect clothing.

• Some acids are more caustic than others, so be smart and always err on the side of caution.

Acid Disposal

Weak acids, such as pickle solution, can be neutralized with baking soda and washed down the sink. Store used caustic acids, such as nitric acid, in a safe, lidded container. When you have a sufficient amount of spent acid, transport it to a local landfill for appropriate storage. There are regulations and procedures as well as fees for this service. Make sure to check into your waste department's rules and policies before using any acids and chemicals that require landfill disposal service.

Flux

It's best to use a flux that does not contain fluorides, especially if the ventilation system in your studio is not as good as you would like. If you have an excellent ventilation system, then use whatever type of flux you like best.

Adhesives

Before using any adhesive, always read and follow the manufacturers safety warnings, which are generally printed on the label. Most adhesives are poisonous. Wear rubber gloves when mixing and applying adhesives. Wear a ventilated mask if you're only using an adhesive for a short amount of time. Otherwise, use adhesives in a well-ventilated area or outside.

Blackening Agents

Many blackening agents, such as liver of sulfur, have a foul odor. As a general rule, if a substance smells unpleasant, it's unhealthy for you to inhale it. Wear a ventilated mask and rubber gloves when using blackening agents. In addition, remove items from these solutions with copper tongs.

Personal Safety & Maintenance

Ventilation

A healthy studio makes for a healthy jeweler. One of the most critical elements of a healthy studio is proper ventilation. Always do the best you can and be aware of all health hazards in the products you use.

The soldering area is a major concern and there are several options for ventilating it. Taking steps to provide some ventilation is always better than no ventilation at all.

• Purchase an inexpensive oven hood from a home improvement store, install the hood over the soldering area, and vent it outdoors.

• Place a fan in front of the soldering area that blows the exhaust out a window.

• Place a fan in front of the soldering area that blows the exhaust away from your breathing space.

• If you use less toxic products, such as fluoride-free flux or citric pickle, you're practicing safer soldering and can get away with less ventilation.

Eye Safety

Wear eye protection at all times, even while sawing. Make sure your protective eyewear is in good shape, free of scratches, and fits comfortably. Clear lenses are acceptable for most procedures, but use shade 5 eye protection for melting metal and didymium or shade 2 eye protection for soldering.

Lung Safety

Proper room ventilation is significant to lung safety, but wearing a ventilated mask will offer even more protection. When sanding and polishing or using flex shaft wheels that break down, wear a face shield or dust mask.

Apparel

Always tie your hair back and make sure not to wear loose clothing or scarves in the studio. Flowing apparel is especially dangerous when using the polishing machine, the drill press, the flexible shaft, a milling machine, or a lathe.

Workspace

Make sure to install all tools correctly and to position them at the proper height for safe and ergonomic use. When working at a jeweler's bench, your chair should be slightly lower than normal and your chin should be level with your bench pin. The average height of a table is 30 inches (76.2 cm) while a jeweler's bench is 36 inches (91.4 cm). This height differential helps you to maintain good posture while sitting and working for long periods of time. You also have better sight lines for making small objects. Do not torment yourself by bending over your work all day. If you work at a standard table, then reduce the legs of your chair to save your back.

Injury Prevention

Repetitive stress injuries are very common in jewelers and people who regularly work with their hands. Preventative measures can be as easy as periodically stopping your work and stretching your hands, arms, and shoulders. The most important measure is to get up from your bench and move around every 30 minutes. Go get a glass of water—most of us need to drink more!

Stretches to Prevent Repetitive Stress Injuries

Stretch 1

• Extend both wrists and fingers out in front of you (as if you're telling an oncoming car to stop with both hands).

• Hold this position for a count of five seconds.

• Relax and straighten both wrists out in front of you.

• With your arms still extended in front of your body, make a tight fist with both hands.

• Bend down both wrists, curling your fists to the floor.

• Hold this position for a count of five seconds.

• Repeat this entire sequence five times.

Stretch 2

• Very slowly roll your head around your entire neck in one direction and then in the other direction.

• Repeat this process five times.

Stretch 3

• Place your hand flat against a wall.

• Turn your body away from your hand, stretching the whole inner arm.

• Hold this position for 10 seconds.

• Repeat this stretch five times on each side of the body.

Stretch 4

• Hold your hands together behind your back.

• Keeping your arms straight, lift up your hands as if you're lifting them over your head.

• When you feel the stretch, hold this position for five seconds.

• Repeat this stretch five times.

Drill Bit Sizes

Drill Bit Number	Diameter in Millimeters	Diameter in Inches
80	0.34	0.014
79	0.37	0.015
78	0.41	0.016
77	0.46	0.018
76	0.51	0.020
75	0.53	0.021
74	0.57	0.023
73	0.61	0.024
72	0.64	0.025
71	0.66	0.026
70	0.71	0.028
69	0.74	0.029
68	0.79	0.031
67	0.81	0.032
66	0.84	0.033
65	0.89	0.035
64	0.91	0.036
63	0.94	0.037
62	0.97	0.038
61	0.99	0.039
60	1.02	0.040
59	1.04	0.041
58	1.07	0.042
57	1.09	0.043
56	1.18	0.046
55	1.32	0.052
54	1.40	0.055
53	1.50	0.059
52	1.61	0.064
51	1.70	0.067
50	1.78	0.070
49	1.85	0.073
48	1.93	0.076
47	1.99	0.079
46	2.06	0.081
45	2.08	0.082
44	2.18	0.086
43	2.26	0.089
42	2.38	0.094
41	2.44	0.096
40	2.49	0.098
39	2.53	0.099
38	2.58	0.101
37	2.64	0.104

Saw Blade Specifications

Blade Size	Blade Thickness	Drill Bit Size for Piercing	Drill Bit Diameter for Piercing
8/0	0.16 mm	80	0.34 mm
7/0	0.17 mm	80	0.34 mm
6/0	0.18 mm	79	0.37 mm
5/0	0.20 mm	78	0.41 mm
4/0	0.22 mm	77	0.46 mm
3/0	0.24 mm	76	0.51 mm
2/0	0.26 mm	75	0.53 mm
1/0	0.28 mm	73	0.61 mm
1	0.30 mm	71	0.66 mm
2	0.34 mm	70	0.71 mm
3	0.36 mm	68	0.79 mm
4	0.38 mm	67	0.81 mm
5	0.40 mm	65	0.89 mm
6	0.44 mm	58	1.07 mm
7	0.48 mm	57	1.09 mm
8	0.50 mm	55	1.32 mm

Abrasive Equivalents
Listed from coarsest (top) to finest (bottom)

Micron Grades (μ)	Sandpaper Grit
80 μ	180
60 μ	220
40 μ	320
30 μ	400
15 μ	600
9 μ	1200
2 μ	6000
1 μ	8000

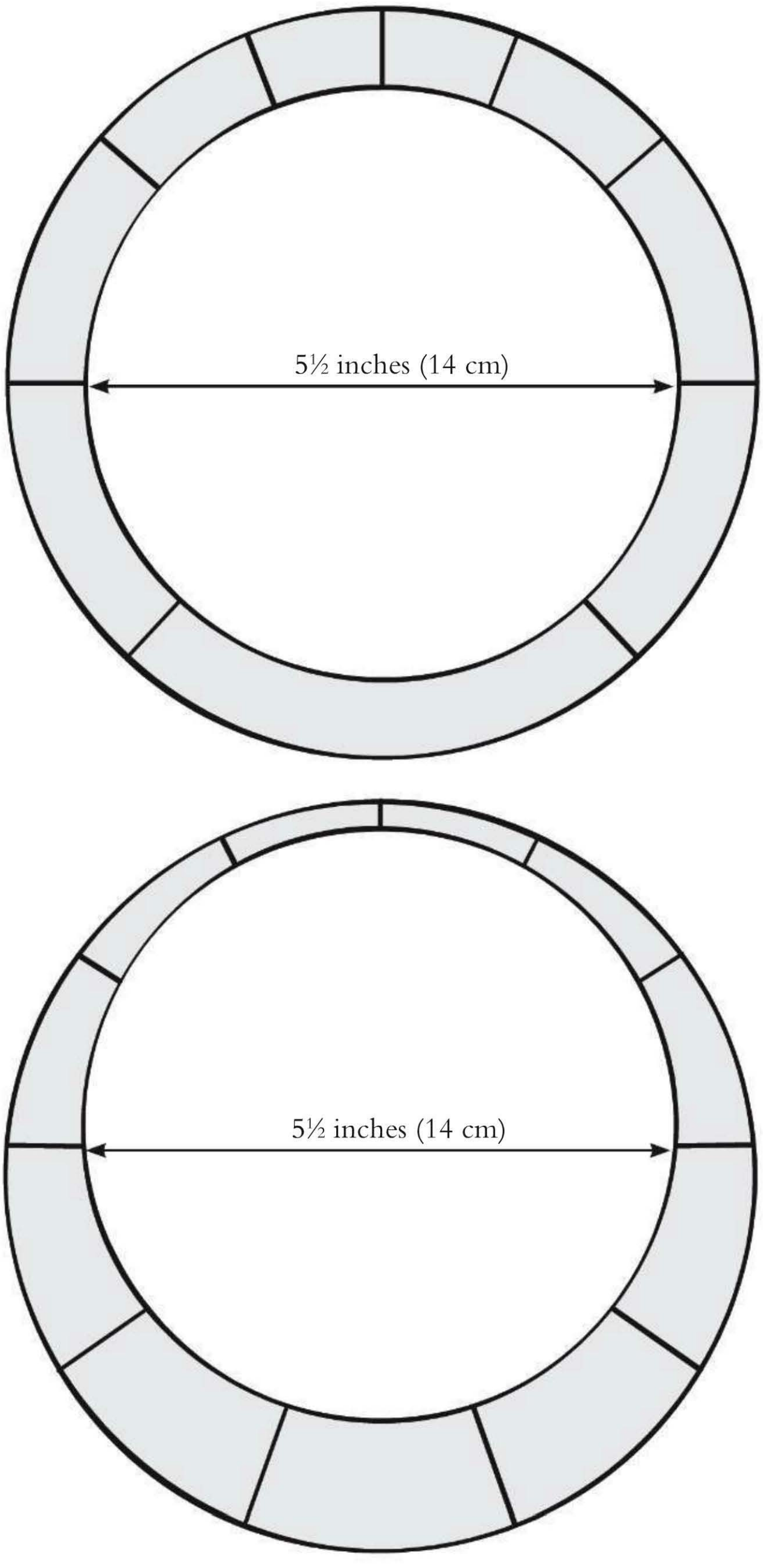
Determining Ring Blank Lengths in B&S Gauge*

Ring Size (US)	Diameter (mm)	Length (mm)	Metal Thickness in Millimeters						
			2 mm	1.6 mm	1.3 mm	1 mm	0.8 mm	0.6 mm	0.5 mm
1	12.44	39.09	45.29	44.09	43.09	42.09	41.49	40.89	40.59
1½	12.85	40.37	46.57	45.37	44.37	43.37	42.77	42.17	41.87
2	13.26	41.64	47.84	46.64	45.64	44.64	44.04	43.44	43.14
2½	13.66	42.92	49.12	47.92	46.92	45.92	45.32	44.72	44.42
3	14.07	44.20	50.40	49.20	48.20	47.20	46.60	46.00	45.70
3½	14.47	45.47	51.67	50.47	49.47	48.47	47.87	47.27	46.97
4	14.88	46.75	52.95	51.75	50.75	49.75	49.15	48.55	48.25
4½	15.29	48.03	54.23	53.03	52.03	51.03	50.43	49.83	49.53
5	15.69	49.30	55.50	54.30	53.30	52.30	51.70	51.10	50.80
5½	16.10	50.58	56.78	55.58	54.58	53.58	52.98	52.38	52.08
6	16.51	51.86	58.06	56.86	55.86	54.86	54.26	53.66	53.36
6½	16.91	53.13	59.33	58.13	57.13	56.13	55.53	54.93	54.63
7	17.32	54.41	60.61	59.41	58.41	57.41	56.81	56.21	55.91
7½	17.73	55.69	61.89	60.69	59.69	58.69	58.09	57.49	57.19
8	18.13	56.96	63.16	61.96	60.96	59.96	59.36	58.76	58.46
8½	18.54	58.24	64.44	63.24	62.24	61.24	60.64	60.04	59.74
9	18.95	59.52	65.72	64.52	63.52	62.52	61.92	61.32	61.02
9½	19.35	60.79	66.99	65.79	64.79	63.79	63.19	62.59	62.29
10	19.76	62.07	68.27	67.07	66.07	65.07	64.47	63.87	63.57
10½	20.16	63.35	69.55	68.35	67.35	66.35	65.75	65.15	64.89
11	20.57	64.63	70.83	69.63	68.63	67.63	67.03	66.43	66.13
11½	20.98	65.90	72.10	70.90	69.90	68.90	68.30	67.70	67.40
12	21.38	67.18	73.38	72.18	71.18	70.18	69.58	68.98	68.68
12½	21.79	68.46	74.66	73.46	72.46	71.46	70.86	70.26	69.96
13	22.20	69.73	75.93	74.73	73.73	72.73	72.13	71.53	71.23
13½	22.60	71.07	77.21	76.01	75.01	74.01	73.41	72.81	72.51

*** If constructing a ring that is more than 4 mm wide, add 0.5 mm to these lengths.**

Sample Sectional Necklace Template

Enlarge templates 200%



Basic Tool Kit

- Bastard file
- Beeswax
- Bench block, steel
- Bench pin
- Burnisher
- Burrs
- Calipers
- Center punch
- Chasing hammer
- Dapping block and punches
- Dividers
- Drill bits
- Dust mask
- Emery paper
- Flexible shaft machine
- Forging hammer
- Hearing protection
- Jeweler's saw frame
- Mandrels
- Needle files
- Pliers
- Rawhide, wooden, or plastic hammer
- Safety glasses
- Safety gloves
- Sandpaper, 220 and 400 grit
- Saw blades
- Scribe
- Separating disk
- Stainless steel ruler
- Wood block
- Wire cutters

Basic Soldering Kit

- Copper tongs
- Cross-locking tweezers with wooden handle
- Embroidery scissors
- Fire extinguisher
- Flux
- Flux brush or other applicator
- Heat resistant soldering surfaces (charcoal blocks, firebricks, or ceramic plates)
- Pickle
- Pickle warming pot
- Safety glasses
- Snips
- Solder (hard, medium, and easy)
- Solder pick
- Soldering torch
- Striker
- Third hand
- Tweezers
- Water for quenching

About the Author

Joanna Gollberg is a studio jeweler in Asheville, North Carolina. *The Ultimate Jeweler's Guide* is the fourth book she has authored for Lark. Joanna's previous books include *The Art and Craft of Making Jewelry* (2006), *Making Metal Jewelry* (2003), and *Creative Metal Crafts* (2004).

Joanna's one-of-a-kind jewelry has recently been exhibited at Quirk Gallery, Richmond, Virginia; Sculptural Objects and Functional Art (SOFA), New York, New York; Mobilia Gallery, Cambridge, Massachusetts; De Novo Fine Contemporary Jewelry, Palo Alto, California; 3rd Ward Jewelry, Milwaukee, Wisconsin; Bellagio, Asheville, North Carolina; Penland Gallery, Penland, North Carolina; and Taboo Studio, San Diego, California. Her work is also available at fine craft shows throughout the country.

Joanna has an A.A.S. in jewelry design from the Fashion Institute of Technology, New York, New York and a B.A. in humanities from Warren Wilson College, Swannanoa, North Carolina.

She has been an instructor at Arrowmont Craft School, Gatlinburg, Tennessee and The Penland School of Crafts, Penland, North Carolina. She has been a guest instructor for universities and metalsmithing groups across the country and abroad, including the Idaho Metal Arts Guild, Tuscon Metal Arts Guild, North Carolina Society of Goldsmiths, Winthrop University, and the Jewelry Production Design Center in Delhi, India.

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